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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SPECIFICATION

OCEANIC DISPLAY AND PLANNING SYSTEM
(ODAPS)

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OCEANIC DISPLAY AND PLANNING SYSTEM
(ODAPS)

1. SYSTEM INTRODUCTION

1.1 SCOPE

This specification defines the requirements for Oceanic Display And Planning System (ODAPS). This system will provide oceanic flight data processing, conflict probe, and oceanic display capabilities for selected domestic Air Route Traffic Control Centers (ARTCCs) which have oceanic control responsibilities. The term domestic ARTCCs applies to ARTCCs within the contiguous United States. The ODAPS equipment procured for this specification will interface with the NAS Stage A Central Computer Complex (CCC), the Service A weather network, non-U.S. ARTCCs, NORAD computer facilities, and Central Flow Control. Through a physical interface with NADIN, ODAF'S will also communicate with Aeronautical Radio, Incorporated (ARINC), the Service B network, and the Aeronautical Fixed Telecommunications Network (AFTN). The ODAPS shall perform flight data processing for all oceanic flights in the ARTCC's area of responsibility, output flight strips to the appropriate sector positions, display calculated aircraft positions, perform the conflict probe function, and output graphic and alphanumeric potential conflict data to ODAPS displays at oceanic sector positions. The NAS Stage A centers shall exchange flight plan data with ODAPS. ODAPS shall process flight plan data and related messages in conjunction with stored adaptation data to produce outputs which shall be transmitted via Flight Data Input/Output (FDIO) control units to FDIO equipment located at oceanic sector positions in the ARTCCs. The FDIO equipment shall use the data output by ODAPS to print flight strips and other messages essential to air traffic oceanic control.

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1.3.1 INTRODUCTION

The primary responsibility of an air traffic controller is to provide safe separation between aircraft operating under instrument flight rules (IFR). In order for the controller to do this, he needs to know the planned route, speed and altitude of the aircraft as well as information on the aircraft's progress along the cleared flight plan path/profile. FDP provides this information. In addition, the FDP assembles and, provides a data base for the other ODAPS fuctions.

1.3.2 AIR TRAFFIC CONTROL ENVIRONMENT

Air Route Traffic Control Centers (ARTCCs) are assigned large geographical areas of responsibility. Within an ARTCC area, the geographical areas of control responsibility are called sectors. The air traffic within each sector is the responsibility of a team of controllers.

Each aircraft flies a route which is specified in the flight plan filed before departure. The controller keeps track of the present position and future positions of the aircraft along that route by monitoring the flight with respect to selected geographical points called "fixes". A fix may be a radio aid to navigation, the intersection of airways, latitude/longitude, or a distance along a radial extending from a navigational aid. The fixes delimiting route segments are reporting points for aircraft.

1.3.3 CONTROL TOOLS

Among the tools the controller uses to perform his tasks are communications facilities, displays, and flight progress strips. Displays show the controllers the present position of each aircraft, as calculated by FDP, with an associated data block that includes the aircraft identifier, its assigned altitude, reported altitude and speed. The flight progress strip presents data derived from or relevant to a flight plan. These strips are removed from a printer and inserted into stripholders at the appropriate controllers' positions. Each flight progress strip will contain a subset of the items of information listed below. The subset of information printed is determined by the function of the flight strip, i.e., en route, departure coordination or update.

Flight identification
Aircraft type
True airspeed
Calculated ground speed
Sector (control area) for which the strip is used
Computer assigned identification number
Number indicating whether this is the 1st, 2nd, 3rd..."n"th flight strip revision for this flight plan. Each strip has a unique number and revision number, as needed
Previous posted fix (reporting point) identification
Time over previous posted fix
Next posted fix identification
Calculated time of arrival at next posted fix
Assigned altitude
Route of flight from departure airport to destination airport
Assigned Beacon code
Identification of a standard departure or arrival to be used
Departure point
Proposed departure time

Flight progress strips are prepared for selected points (fixes) on the route of flight. A flight progress strip is called a "posting" and a fix for which a strip is prepared is called a "posted fix". In addition to the strips prepared for each fix along the route of flight, replacement strips may be prepared when messages are received that modify the flight plan information.

1.3.4 FLIGHT DATA PROCESSING

Flight data processing (FDP) is the processing of input flight plan data and stored adaptation data required to prepare flight progress strips, and the output of the strips to the appropriate controller positions in the ARTCCs.

1.3.4.1 FLIGHT PLAN DATA INPUTS

Each pilot flying under FAA Instrument Flight Rules (IFR) is required to file a flight plan with an air traffic control facility. A flight plan specifies the point of departure, proposed time of departure, destination, route and altitudes to be flown, true air speed, and other essential elements of information. The FDP function normally receives flight plans via flight plan messages transmitted by a local source (e.g., sector controller) or a remote source (e.g., AFTN, ARINC). The information in the flight plan is processed by the FDP system which applies stored data, rules, and logic to generate the essential elements of information required by the controller.

1.3.4.2 FDP SYSTEM STORED DATA

In order to derive, from the flight plans, elements of information which include essential data to the controllers, the FDP system processes the flight plan data using stored data and computer programs. The data and programs stored include: adaptation data, which are unique to the center's area of responsibility; logic and rules for processing; aircraft characteristics; message and message field data; parameters; and other essential data. Bulk store capability will not be required in ODAPS.

1.3.4.3 PROGRESS FUNCTIONS

Flight data processing begins with the input of a flight plan. Error checking routines are performed on the flight plan, which is accepted if error-free. If errors are found, the source is notified by message. An accepted flight plan is processed according to the contents of the fields. Such functions as direct route processing, route conversion, fix posting, calculation of time of arrival, and strip addressing are performed by applying the stored data, logic, and rules to the flight plan contents. The resultant flight progress strips are addressed and transmitted to the Flight Strip Printers at each control position responsible for a phase of that flight. Subsequently, these strips can be amended (updated) or removed by messages.

1.3.4.4 ODAPS FDP FLIGHT PLAN OPERATIONS

1.3.4.4.1 CONTINENTAL U.S. (CONUS) DEPARTURES

Flight plans for CONUS originating flights (air carrier, general aviation, military) are resident in the 9020 CCC data base. Once identified as including an oceanic routing, the flight plan will be passed at the appropriate time from the 9020 CCC to ODAPS FDP. On flights departing from airports proximate to the ODAPS airspace boundary, the 9020 CCC will, upon the flight's departure, forward a departure message to ODAPS. Otherwise, on flights departing non-proximate airports, the initial flight plan transmission by the 9020 CCC to ODAPS will include the current time estimate to arrive at the ODAPS airspace boundary.

1.3.4.4.2 OTHER FLIGHT PLANS

Flight plans also enter ODAPS oceanic airspace from adjacent oceanic airspace other than that served by the 9020. Generally, the initial flight plans on such flights will be received via AFTN. The subsequent activation of the flight plans will be either via on-line input from the adjacent (foreign state) airspace automation system, or via an ODAPS controller with data as received via phone from the adjacent airspace controller.

1.3.4.4.3 AIR FILE

On occasion aircraft may enter ODAPS oceanic airspace without a flight plan having been received. This can occur as the result of a breakdown in communications or procedures, and will require the controller to obtain and enter into ODAPS the full flight plan.

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1.3.4.6 ODAPS FLIGHT PLAN OPERATIONS CONCEPT

The ODAPS concept of operations, in general, is driven by a timeline. This timeline contains the following general events which are not all inclusive:

(1) Processing prior to flight plan activation,

(2) Transition into the ODAPS oceanic control,

(3) Fix reporting,

(4) Conflict probe, and

(5) Transition from ODAPS.

These are activities that are performed as each aircraft enters, passes through, and departs the oceanic airspace. The activities may be performed simultaneously for various aircraft, so that a number of aircraft may be undergoing processing prior to flight plan activation, while a number of aircraft may be reporting fixes and yet another number of aircraft undergoing conflict probing.

The final activity is when transfer is passed to a receiving ARTCC or other facility. After elapsed times (a parameter), the data block and related flight plan data are dropped. An ODAPS historical data recording system shall be used to record these events.

1.3.4.6.1 TRANSITION TO ODAPS

At a parameter time prior to the aircraft entering ODAPS oceanic airspace, a position symbol and a full data block shall be generated for that flight and displayed at the calculated position on the situation display of the sector whose airspace the flight will initially be under contol.

1.3.4.6.2 FIX REPORTING

Fix reporting is accomplished at approximately one (1) hour intervals of flight. Position reports will be entered into ODAPS on-line or via a keyboard entry at the position. If the received data (position or altitude) does not agree with that stored by ODAPS, or if the time varies by a parameter value, a progress report validation message will be generated for controller review. If necessary, the controller will seek verification. If necessary, the data will then be revised and/or validated by the controller, and then, ODAPS will update, or print new strips, modify the situation display and/or trigger a conflict probe as indicated.

1.3.4.6.3 CONFLICT PROBE

Conflict probe is automatically enabled with flight plan activation. Subsequent execution of the conflict probe occurs automatically, at parameter intervals, e.g. 1 hour, and if (1) the flight has reported over a fix at a time that varies from the calculated estimate by some value, or (2) the controller has amended the flight to a different speed different altitude, or different route. If the pilot requests a new speed, altitude or route the controller may choose to test the request by entering a manual probe request with the requested change. An analysis of the potential conflicts, if any, acruing from the proposed change will be made and presented to the controller. Unless and except as specified otherwise in a manual request, the data used in probes are the current speed, time, altitude and route.

1.3.5 FIX TIME CALCULATION

The route documented in an aircraft's flight plan shall consist of identified routes and/or fixes. Upon receipt of the flight plan, with the imbedded route, route conversion is performed, resulting in a series of fixes from which a list of fix postings are developed. Any geographical point explicitly identified in a flight plan or implied by the plan can be considered a fixed posting. Using the stored winds aloft data and the filed speed, a ground speed is determined for each route segment. Fix times are then calculated using the ground speed and the distances fix to fix. The calculated fix times are included in the flight progress strips used by the ODAPS controllers.

1.3.5.1 DEFINITION OF FIX POINTS

A fix may be defined in several ways:

(a) LATITUDE AND LONGITUDE,

(b) NAME - The latitude and longitude corresponding to the name will have been stored with ODAPS during adaption.

(c) FRD OR FIX-RADIAL-DISTANCE - The fix is specified as an offset from a named fix. The offset is given as the heading from the reference fix point and a radial distance.

(d) IMPLIED FIX (ROUTE-CROSSING-FIX) - This fix is defined by naming two established routes stored with ODAPS during adaption. The fix point is the unique intersection of these routes. The fix definition is rejected if there is no intersection point or more than one.

1.3.5.2 FIX POINT DETERMINATION

Paragraph 1.3.5.1 listed the type of fix points that are encountered in fix time calculations. Fix points that can be used for a flight are determined during route conversion as described in this specification in paragraph 3.4.3 and 3.5.

1.3.5.3 POST DETERMINATION

The term post determination is applied to the process of selecting fix posting points from the available fix points along the route. There shall be at least two options (methods) available to the controller for post determination. In priority, the selectable two options are as follows:

(a) BY REGULATION: ODAPS must derive fix postings from the flight plan in accordance with rules established by ICAO and the FAA.

(b) BY FLIGHT PLAN: The pilot shall declare in advance the route turning points. ODAPS will post these points.

1.3.5.4 COMPUTATIONS FOR FIX TIME CALCULATION

ODAPS shall calculate the time of fix posting events at several occasions during a flight. These events are as follows:

(a) When a conflict probe APREQ is entered,

(b) When the flight plan is activated for the oceanic airspace,

(c) When the route or speed is changed, or

(d) When an altitude change occurs that requires posting in different sector(s) or stratum(s).

Each of these calculations results in the generation of flight progress strips or update messages and the automatic initiation of a conflict probe.

The fix time computation is primarily a calculation of time, rate, and distance. However, the true airspeed of the aircraft contained in the filed flight plan must be converted to ground speed. This conversion requires a knowledge of the upper winds (winds at the altitude of the aircraft). For this reason, ODAPS shall maintain an accurate data base of current winds aloft. In addition, the system will utilize in SITU measurements of the wind reported by aircraft in flight. The conversion of true airspeed to ground speed is discussed in MITRE Working Paper 81W00230 by R. S. Conker, June 1981.

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The following are National Airspace System Configuration Mangement Documents, paragraph references apply to issues dated April 14, 1980:

NAS-MD-310	Computer Program Functional Specification (CPFS) Introduction to Series
NAS-MD-311	CPFS, Message Entry and Checking
NAS-MD-312	CPFS, Route Conversion and Posting
NAS-MD-313	CPFS, Flight Plan Position Processing and Beacon Code Assignment
NAS-MD-314	CPFS, Local Outputs
NAS-MD-315	CPFS, Remote Outputs
NAS-MD-316	CPFS, Adaptation
NAS-MD-326	Adaptation Format Guide
NAS-MD-349	Data Reduction and Analysis Program for A3d2
NAS-MD-601	Interface Control Document
NAS-MD-610	Interfacility Data Transfer
NAS-MD-750	NADIN-NAS Interface
NAS-MD-850	CFCC/NAS Stage A En Route CCC ICG

2.3 <u>FAA STANDARDS</u>

FAA-STD-002	Engineering Drawings
FAA-STD-010	Graphic Symbols for Digital Logic Equipment
FAA-STD-013	Quality Control Program Requirements
FAA-STD-018	Computer Software Quality Program Requirement
FAA-STD-019	Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities
FAA-STD-020	Transient Protecting, Grounding, Bonding, and Shielding Requirements for Equipment
FAA-STD-021	Configuration Management
FAA-STD-025	Interface Control Documentation

2.4 OTHER FAA DOCUMENTS

FAA Handbook 6040.10	Equipment Failure Handbook
FAA Handbook 7110.65B	Air Traffic Control
FAA Handbook 7110.83	Oceanic Air Traffic Control
FAA Order 1370.148	Flowchart Symbol Standards
FAA-2000-2	IBM 9020 Data Processing System Maintenance Monitor Manual
FAA 4015	Interfacility Equipment Subsystem Operating Manuals (Test and Maintenance)

2.5 OTHER DOCUMENTS

MIL-STD-470	Maintainability Program Requirement for Systems and Equipment
MIL-STD-471	Maintainability Verification Demonstration and Evaluation
MIL-STD-781	Reliability Tests, Exponential Distribution
MIL-STD-785	Reliability Programs for Systems and Equipment Development and Production MIL-E-17555 Electronic and Electrical Equipment, Accessories, and Repair Parts, Packaging and Packing of
MIL-STD-1472B	Human Engineering Design Criteria for Military Systems Equipment and Facilities
MIL-E-17555G	Electric and Electric Equipment, Accessories and Repair Parts, Packaging and Packing of

FIPS PUB 38	Guidelines for Documentation of Computer Programs and Automated Data Systems
MITRE Technical Report 7605	Description of the En Route Flight Plan Probe Function
MITRE Working Paper 11735	Preliminary Design Specification: En Route Flight Plan Conflict Probe
ICAO DOC	Rules of the Air and Air Traffic Services, 4444-RAC/501/10 Procedures for Air Navigation Services, International Civil Aviation Organization (ICAO)
ICAO ANNEX 10	Aeronautical Telecommunications, International Standards, Recommended Practices and Procedures for Air Navigation Services, Convention on International Civil Aviation
FED-STD-595	Colors
National Electric Code	

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The MITRE documents are referenced for the express purpose of providing information on the conflict probe function and approaches to the processing of that function. Additionally, FAA programs are available that have been developed by MITRE in response to evaluating FAA requirements for an En Route Flight Plan Conflict Probe function.

(Copies of this specification and other applicable FAA specifications, standards, handbooks, and drawings may be obtained from the Contracting Officer in the Federal Aviation Administration Office issuing the invitation for bids or request for proposals. Requests should fully identify material desired, i.e., specification, standard, amendment, and drawing numbers and dates. Requests should cite the invitation for bids, request for proposals, or the contract involved or other use to be made of the requested material.) (Single copies of Military specifications and standards may be requested by mail or telephone from U.S. Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, PA 19120 (for telephone requests call 215-607-3321, 8:00 a.m. to 4:30 p.m., Monday through Friday). Not more than five items may be ordered on a single request and the Invitation for Bid or Contract Number should be cited where applicable.

(Copies of ICAO documents may be obtained from the International Civil Aviation Organization, (ATTN: Distribution Officer), P.O. Box 400, Succersale: Place de l'Aviation Internationale, 100 Sherbrooke St. West, Montreal, Canada H3A 2R2.)

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3.2.1.1 FLIGHT DATA PROCESSIING

The flight data processing (FDP) functions shall maintain a comprehensive data base to support the situation display, strip production and conflict probe subsystems. In general, FDP shall perform the following:

(a) Local and remote message acceptance checking for legality, format and eligibility.

(b) Route conversion.

(c) Fix posting determination.

(d) Fix time calculation.

(e) Flight plan position extrapolation.

(f) Flight progress strip printing and routing.

(g) Situation display processing support. Capable of supporting up to a maximum of ten (10) operational displays for each ODAPS.

(h) Conflict probe analysis support.

ODAPS flight data processing shall require flight plan data inputs for all flights intending to be entered into its airspace. Flight plans shall be entered into the ODAPS FDP at some predetermined time prior to the expected departure or entry into oceanic airspace. The flight data processing function shall then perform tasks such as route conversion and fix time calculations, leading to flight progress strips generation, as well as providing the data base to support probe analysis and display processing functions.

The contractor shall provide information in order that the FAA can modify the ARTCC adaptation required for the ARTCC interface with the ODAPS flight data processor.

3.2.1.2 DISPLAY PROCESSING

The situation display shall provide the oceanic controller with a graphic representation of the flight plan extrapolated position of all active aircraft. The display shall be capable of displaying alpha-numeric data, time, map data, aircraft position symbols, data blocks, route displays, and velocity vectors.

3.2.1.3 PROBE ANALYSIS

The conflict probe function shall consist of determining from flight plan data, resident in the ODAPS data base, whether the spatial relationship between a given flight and any other flight, or airspace reservation will be less or potentially less than the applicable separation minimum. It shall also provide, in a timely manner, definitive information on that spatial relationship to the controller. Separation criteria specified in FAA Handbook 7110.83 shall be used to determine the procedures and minima normally applied to aircraft operating within oceanic airspace.

3.2.1.4 INTERFACES

To provide ODAPS with the necessary data base and to efficiently exchange flight plan data, on-line interfaces shall be established with other facilities, including ARTCC automation systems, and with NADIN.

INTERFACES REQUIRED:

(a) Domestic ARTCC automation systems. ODAPS shall interface with up to six (6) ARTCC automation systems. These shall be either 9020 computer systems or Host Computer System processors.

(b) Weather Message Switching Center (WMSC - Service A Weather)

(c) North American Air Defense Center(s).

(d) Non-U.S. Air Traffic Control Systems.

(f) National Data Interchange Network (NADIN). ODAPS will interface with NADIN for communication with ARINC, AFTN, and the Service B network.

(g) Central Flow Control Facility (CF2).

(h) Offshore Flight Data Processing System (OFDPS). ODAPS shall interface with up to three (3) OFDPS.

ODAPS interfaces shall be designed so that the ODAPS FDP looks like an adjacent ARTCC and no major software changes should be required (adaptation only). Details pertaining to these messages are described in this document.

3.2.1.5 SUPERVISORY/PLANNER POSITION

The ODAPS system shall support this unique position for on-line management. This position will, through an input/output device be eligible for input/output of flight data messages, including the following:

(a) Planned shutdown. Provides advanced printing of flight progress strips.

(b) Start processing, Starts automated mode, either initial or restart.

(c) Resector. Establish or modify current sectorization.

(d) Interfacility transmission enable/suppress to individual inter-facility data links; e.g., ARINC, etc.

(e) Inhibit waiting response.

(f) Correction messages.

(g) Read/modify memory.

(h) Change parameter.

(i) Activate/inhibit system recording.

(j) Capability to extract the number of active flights and/or the number of inactive flights either by total or for a defined period.

(k) Enter/cancel route. To provide capability to enter a route for processing as if it were an adapted route.

(l) Display FIR boundary time and position of flight.

(m) Display defense identification zone boundary time and position of flight.

(n) Display time at compulsory reporting points for flight.

(o) System load. Provides capability to extract the number of flights either by total or for a defined period.

(p) All input messages which do not require a PVD for output

(q) The CT message (Construct/Delete Temporary airspace reservation)

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3.3.1 MESSAGE DESCRIPTION

The paragraphs in this specification relating to Inhibit Waiting Response (NAS-MD-311) referenced in Table II are to be considered part of this specification in so far as they apply to flight data processing functions and ODAPS terminals.

3.3.1.1 MESSAGE SIZE

The maximum number of characters that shall be accepted in one message, from the sources indicated, is as follows:

(a) Keyboard - 400.

(b) IOT - 400.

(c) Remote FDIO - 400.

(d) NADIN - 3700.

(e) Card Reader - 80 per card for a maximum of 500 cards.

3.3.1.2 FIELD DEFINITION

A field is defined as one or more contiguous nonspace characters separated from each adjacent field by a space. The first field of a message need not be preceded by a space, nor the last field of a message be followed by a space. Each message field is assigned a reference number and some fields have abbreviations. Each field description, its reference number, and field abbreviation, if any, is shown in Table I; many fields shown will not be used for the ODAPS but are included to show the complete format.

3.3.1.3 ELEMENTS

Each field of data consists of one or more elements which are generally separated from other elements in the same field by any one of several special characters.

3.3.1.4 MESSAGE ACCEPTANCE

Each input message shall be subjected to acceptance checks as described herein. There shall be a computer-generated response for every message within a parameter response time as defined in Section 14.2. The response shall be an acceptance message, a rejection message, or error message. Error and rejection messages shall identify the error or reason for rejection. A rejection message shall be for the first error encountered to cause rejection, and the entered message shall be removed from storage. An error message shall be for the first error encountered, and the message shall be retained pending corrections. When an error is corrected, then the next of any remaining errors shall be identified to the source. The method of correcting the message shall consist of using the CM or CR messages and entering the appropriate fields.

TABLE I

STANDARD INPUT MESSAGE FIELDS
(Refer to NAS-MD-311 for more detail)

FIELD REFERENCE NUMBER	FIELD NAME (ABBREVIATION, IF ANY)
00	Source Identification
01	Message Type
02	Flight Identification (AID)
03	Aircraft Data (TYP)
04	Beacon Code (BCN)
05	Speed (SPD)
06	Coordination Fix (FIX)
07	Coordination Time (TIM)
08	Assigned Altitude (ALT)
09	Requested Altitude (RAL)
10	Route (RTE)
11	Remarks (RMK)
12	Field Reference Number or Field Reference Abbreviation
13	Location Identifier
14	Sector Identifier
15	Message Cancellation Group
16	Output Routing
17	Amendment or Correction Data
18	Progress Report
19	Upper Wind Altitude
20	Upper Wind Data
21	Hold Data
22	Mission Data
23	Track Position Velocity Components
24	Not Used
25	Referent Message Descriptor
26	Departure Airport
27	Destination Airport
28	ETE/ETA
29	Acceptance Data
30	Sector Change
31	Data Selection Indicator
32	Planned Shutdown Start Time
33	Planned Shutdown Stop Time
34	Altimeter Data
35	Altimeter Data Entrance Time
36	Action Indicator
37	Parameter Designator
38	Parameter Value
39	Change Status
40	Control Figures
41	Established Beacon Code
42	Flight Data Selection
43	Not used

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32	Planned Shutdown Start Time
33	Planned Shutdown Stop Time
34	Altimeter Data
35	Altimeter Data Entrance Time
36	Action Indicator
37	Parameter Designator
38	Parameter Value
39	Change Status
40	Control Figures
41	Established Beacon Code
42	Flight Data Selection
43	Not used

3.3.1.5 MESSAGE CHECKS

Format checks are those that ascertain that the required fields are present and in the proper sequence. The following identifies checks that shall be made on all messages.

3.3.1.5.1 FIELD 00 (SOURCE IDENTIFICATION) CHECKS

Field 00 is required on all messages from remote sources except those originating from non-U.S. facilities. The format of the field may differ depending on the source. The capability shall be provided for adaptation so that certain teletype sources can be classified as unanswerable. When so adapted, a message sequence check shall be provided to assure that the sequence number (the last three digits of Field 001), of a received message is one higher than the sequence number of the preceding message. When in error, an out-of-sequence message shall be output to an adapted IOT.

3.3.1.5.2 FIELD 01 (MESSAGE TYPE)

Checks shall be performed to ensure that Field 01 is an identifiable message type from an acceptable source.

3.3.1.6 LOGIC CHECKS

Where feasible, the capability to adapt a normally expected range of values for specific messages shall be provided; values outside this range shall result in an error message.

3.3.1.7 DATA CHECKS

A check shall be made on all parity and logic check (e.g., EOM) characters on each input message. When Field 00 is valid and a transmission error has been detected, a Retransmission Message shall be output to the source. When Field 00 is invalid and a transmission error has been detected, an appropriate message shall be output to an adapted IOT.

3.3.1.8 COMPATIBILITY CHECKS

Messages received that require route conversion and posting determination shall be [illegible] the format and logic checks as specified [illegible] the route conversion and posting [illegible] when the flight plan is [illegible] rejection message shall, be output to the [illegible] the source is a remote source, a rejection message [illegible] output only to an adapted IOT. When the flight plan is the initial entry and a compatibility exception exists, the flight plan shall not be absorbed into the data base; if not the initial flight plan then the flight plan shall remain in the data base as it was prior to the compatibility exception. During the route conversion and posting determination process, it shall be determined when flight plans are incompatible with the ODAPS flight data processor. This situation can result from one or more of the following: illogical adaptation data such as when a converted route contains no postable fixes in the center control areas; dynamic data base overflow or buffer shortage; a larger number of postings than that defined in adaptation; or excessive flight duration such as when the program detects a flight of total duration greater than six days. Refer to NAS-MD-311, 1.6.2.4 for more details.

3.3.1.9 GENERAL LEGALITY CHECKS

Checks shall be made for the following:

(a) Presence of required fields;

(b) Proper format of fields;

(c) No presence of a field other than those specified as required or optional;

(d) Presence of a valid field separator;

Refer to NAS-MD-311, 1.6.2.5 for further details.

3.3.1.10 ERROR MESSAGES

All error, rejection, or other messages shall be clear and concise using mnemonic notations.

3.3.2 MESSAGE TYPES

Message types are divided into six categories:

(a) FLIGHT DATA (FD) - Used to establish and maintain the flight plan data base.

(b) INFORMATION REQUEST (IR) - Used to request display or printout from the data base.

(c) SUPERVISORY (S) - Used to control various processes relating to the system environment, such as resectorization.

(d) INTERFACILITY (IF) - Those messages that are transmitted to and received from a device, other than an FDIO, in another facility between NADIN and the ODAPS. All references to NADIN in 4.2 and subparagraphs shall be interpreted as NADIN or AFTN.

(e) MISCELLANEOUS (MI) - Used to input and route certain information to assist in the orderly process of air traffic control. This message is referred to as General Information.

(f) DISPLAY MESSAGE (DP)

The message types, categories, and names for the messages are shown in Table II.

TABLE II

MESSAGE NAMES, TYPES AND DESIGNATORS

MESSAGE TYPE	MESSAGE CATEGORY	MESSAGE NAME	PARAGRAPH
AM	FD-IF	Amendment Message	4.2.1
CM/CR	FD	Correction Message	4.2.2 and 8.1.1
CP	S	Change Parameter	8.1.1
CS	S	Resector	8.1.1
CT	DP	Construct/Delete	5.2.7
DA	IF	Transmission Accepted	7.11
DEP	FD-IF	ICAO Departure	4.2.3
DM	FD	Departure	4.2.4
DR	IF	Transmission Rejected	7.11
DT	IF	Data Test	7.11
DX	IF	Retransmit	7.11
FP	FD-IF	Flight Plan	4.2.5
FPL	FD-IF	ICAO Flight Plan	4.2.6
FR	FD	Flight Plan Readout Request	4.2.7
GI	MI	General Information	8.2.2
GO	S	Start Processing	8.1.1
HM	FD-IF	Hold	4.2.8
IS	S	Inhibit Transmission	8.1.1
IW	S	Inhibit Waiting Response	NAS-MD-311
MP	FD	Mission Flight Plan	4.2.9
MR	DP	Map Request	5.4.3
PA	IR	Probe Analysis Request	6.2
PR	FD-IF	Progress Report	4.2.10
PS	S	Planned Shutdown	8.1.1
PV*	FD	Progress Report Validation	4.2.11
QP*	DP	Point Out	5.2.2
QP*	DP	Reposition List	5.2.3
QP*	DP	Request/Suppress Data Block	5.2.4
QU	DP	Route Display	5.2.5
QX	DP	Drop Track	5.2.1
QZ	DP	Data Block Offset	5.2.6
RC	S	Sector Assignment Request	8.1.1
RS	FD-IF	Remove Strip	4.2.12
SR	FD	Strip Request	4.2.13
TD	IR-IF	Test Device	4.2.14
TR	IF	Test Message	4.2.15
UR	IR	Upper Wind Request	4.6.2
UW	IF	Upper Winds	4.6.1.1

* The differences in formats will differentiate between actions within a single message type.

3.4 FIELD 10 (ROUTE) CHECKING

Field 10 (Route) of a flight plan contains the filed route of flight. This route shall consist of ATS routes and/or fixes. A fix is one which has been previously identified to the program by the process of creating a table consisting of the fix names and locations in some coordinate system. An adapted route shall consist of ATS routes, and adapted direct routes that connect adapted fixes. (Refer to Appendix 20 for a definition of terms.) A nonadapted route shall consist of a nonadapted route segment between two adapted fixes. The following subparagraphs describe the process of checking the contents of Field 10.

3.4.1 FIELD 10 ELEMENT DESCRIPTION

Details of Field 10 element descriptions are contained in NAS-MD-312, 3.0 and its subparagraphs.

3.4.2 FIELD 10 (ROUTE) FORMAT CHECK

3.4.2.1 FIELD 10 FORMAT

Checks shall be made to ensure the following:

(a) The first element is a fix;

(b) The last element is a fix or VFR, DVFR, or XXX (incomplete route indicator);

(c) Fixes and routes are separated by a period (.) when they alternate; consecutive routes and consecutive separated by two periods (..).

When the Field 10 violates any format criteria, an appropriate error message shall be transmitted. Other details are contained in NAS-MD-311, 4.1, and Tables 4-l and 4-2.

3.4.2.2 FIELD 10 SIZE

The maximum number of elements allowed in Field 10 shall be 48, including the slash character (/) used as a tailoring indicator.

3.4.3 ROUTE LOGIC AND ADAPTATION CHECKS

These checks shall be performed to ensure that the data in Field 10 are compatible with adaptation and other data in the flight plan. Paragraphs 3.4.3.1 through 3.4.3.3 describe the determination of the first, second, and last fixes to be converted which shall be a part of route logic and adaptation checks. Actual route conversion is described in 3.5 herein. Refer to NAS-MD-312, 6.0 for further details.

3.4.3.1 FIRST CONVERTED FIX DETERMINATION

The determination of the first fix to be converted shall be as follows:

(a) When a tailoring (/) symbol is present (indicating that the route prior to it has been eliminated), the Coordination Fix (Field 06) shall become the first converted fix.

(b) When the second element is VFR or DVFR, the ODAPS shall ensure that the third element is a fix. The first converted fix shall be the fix following VFR or DVFR.

(c) When the Coordination Fix is the same as the first element processing shall be done from the coordination fix to the second element in Field 10, and the coordination fix shall become the first converted fix. When the departure point is an adapted airport and the entered time is P or D-time, the X-Y coordinates of the airport shall be used for the first converted fix.

(d) When the first element is followed by two consecutive element delimiters, processing shall be done from the Coordination Fix direct to the second fix in Field 10 and the Coordination Fix shall become the first converted fix. When the Coordination Fix and the second fix in Field 10 are the same, the second fix in Field 10 shall become the first converted fix.

(e) When the second element in Field 10 is an adapted route, processing shall be done from the Coordination Fix to the second element and the Coordination Fix shall become the first converted fix.

3.4.3.2 SECOND CONVERTED FIX DETERMINATION

After the first converted fix has been determined at least one route segment, beginning with the first converted fix shall be required. Otherwise, an error message shall be returned to the source.

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(c) When the Coordination Fix is the same as the first element processing shall be done from the coordination fix to the second element in Field 10, and the coordination fix shall become the first converted fix. When the departure point is an adapted airport and the entered time is P or D-time, the X-Y coordinates of the airport shall be used for the first converted fix.

(d) When the first element is followed by two consecutive element delimiters, processing shall be done from the Coordination Fix direct to the second fix in Field 10 and the Coordination Fix shall become the first converted fix. When the Coordination Fix and the second fix in Field 10 are the same, the second fix in Field 10 shall become the first converted fix.

(e) When the second element in Field 10 is an adapted route, processing shall be done from the Coordination Fix to the second element and the Coordination Fix shall become the first converted fix.

3.4.3.2 SECOND CONVERTED FIX DETERMINATION

After the first converted fix has been determined at least one route segment, beginning with the first converted fix shall be required. Otherwise, an error message shall be returned to the source.

3.4.3.5 SPECIAL ELEMENT CHECKS

The ODAPS flight data processor shall process the following special elements which may be contained in Field 10: VFR (Visual Flight Routes), DVFR (Defense Visual Flight Rules), XXX (Incomplete Route Indicator).

(a) VFR, DVFR - When either of these elements is the second element in Field 10, the ODAPS flight data processor shall ensure that the fix following the element is internal to the center's airspace at the filed altitude. When VFR or DVFR is other than the second element, the ODAPS flight data processor shall ensure that the element preceding the VFR/DFVR element is an acceptance fix.

(b) XXX - When XXX, the Incomplete Route Indicator, appears in Field 10, the ODAPS flight data processor shall ensure that the element preceding it is an acceptable fix. When a flight plan is received from AFTN or NADIN that is only partially processable, the ODAPS flight data processor shall insert an incomplete route indicator after the last processable element.

3.4.3.6 DISTANCE CHECK

The ODAPS flight data processor shall generate an error message when the entry fix and exit fix of an adapted route are the same, and the fix appears only once on the adapted route. A zero distance on a direct route shall be acceptable, but zero distance on an entire route shall not be acceptable.

3.4.3.7 ADAPTATION CHECK

The ODAPS flight data processor shall ensure that all filed fixes in Field 06 (Coordination Fix) and Field 10 (Route) are adapted fixes, qualified latitudes/longitudes, or fix-radial-distances of fix names that are adapted. The ODAPS shall ensure that all route elements between the first and last fix elements to be converted, are adapted except XXX, VFR, and DVFR. The adaptation check shall validate to the last adapted fix in, or first adapted fix external to, the ARTCC oceanic area of responsibility.

3.5 ROUTE CONVERSION AND POSTING (EN ROUTE)

Route conversion is the process of expanding each route segment, filed in Field 10 of a flight plan message, into the component fixes making up the route, connecting geographical positions to the system coordinate system, and converting all information into a form useable to the processors. Component fixes that describe an adapted route are found in adaptation. Fixes along direct routes shall be determined in accordance with direct route conversion rules. When the route elements VFR or DVFR appear in Field 10 as the second element, route conversion shall begin with the fix following the VFR or DVFR. The fix following the VFR or DVFR shall always be posted for the FPA appropriate at the processing altitude. Route conversion shall begin with the coordination fix of a flight which originates as an airfile in the center area with other than VFR or DVFR as the second element. The coordination fix always shall be posted for the FPA appropriate at the processing altitude. When the route elements VFR, DVFR, or XXX appear in Field 10 in other than the 2nd element, route conversion shall end with the fix preceding the VFR, DVFR, or XXX. Elements beyond shall not be converted. The fix preceding VFR, DVFR, or XXX shall be always posted for the FPA appropriate at the flight altitude. Airfile points always shall be posted.

3.5.1 ADAPTED ROUTE CONVERSION AND POSTING PRIORITIES

The adapted fixes on an adapted route between the entry and exit fixes, filed or implied, of a filed route segment shall be converted. A priority scheme shall apply to the posting of fixes on adapted routes; this shall be subject to the approval of the FAA.

3.5.1.1 ELIMINATION OF DUPLICATE POSTINGS

For each fix on an adapted route, it shall be possible to adapt a list of FPAs to be used when outputting strips for each fix on the adapted route. When this information is omitted from route adaptation, the information contained in fix adaptation shall be used to determine FPA postings. When this list is adapted, the first FPA in the list shall be the primary FPA, i.e., the FPA which contains the fix. For an adapted route, duplicate primary and alternate postings for FPAs shall be eliminated based on direction priority at processing altitude within an FPA.

3.5 ROUTE CONVERSION AND POSTING (EN ROUTE)

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The adapted fixes on an adapted route between the entry and exit fixes, filed or implied, of a filed route segment shall be converted. A priority scheme shall apply to the posting of fixes on adapted routes; this shall be subject to the approval of the FAA.

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3.5.2.2.2 FIX POSTING LINES

The use of fix posting lines may be employed by the contractor if desired (Reference NAS-MD-312). Any technique, developed in lieu of fix posting lines, will be acceptable provided that fix posting is done properly. One fix posting line as described in NAS-MD-312 is as follows:

S - Line: On a direct route, an S-Line crossing point will force a fix posting for the FPA specified by the S-Line.

3.5.2.2.3 ROUTE SEGMENT INTERSECTIONS

Segments of airways or fix posting lines that lie within an FPA may be specified in adaptation for posting of the intersections of direct routes with these segments.

3.5.2.2.4 CLOSEST POINT TO FOCAL POINT FIX

When no criteria apply to posting a fix, the point of intersection of the perpendicular from the focal point fix (FPF) with the route segment shall be computed and posted. When an FPA has no FPF, and no posting criteria applies, the FPA entry point shall be calculated and posted.

3.5.2.2.5 LATITUDE AND LONGITUDE

The capability shall exist to post every 10° of latitude or longitude. If the time between positings exceeds (system parameter) minutes, the postings shall be every 5° of latitude or longitide. Flexibility shall be provided in adaptation to suppress postings under definable conditions.

3.5.3 ADAPTED DIRECT ROUTE PROCESSING

When two consecutive fix names are filed in Field 10 of a flight plan, the program shall determine whether an adapted direct route applies. When an adapted direct route applies, the converted fixes as specified by adaptation shall be used for the direct route segment. The fixes shall be posted according to the processing rules for the adapted routes that replace the direct segments.

3.5.4 SPECIAL POSTING REQUIREMENTS

Special requirements for posting are:

(a) When the fix preceding XXX, VFR, or DVFR is not already postable in the last center FPA at the flight's last processing altitude, it shall be posted at that altitude.

(b) It shall be possible to specify mandatory posting in adaptation.

(c) When a combination of one or more altitude transitions, concaveshaped FPAs, or unusual adaptation at a route junction causes a primary route record sequence to exit and then re-enter an FPA without progressing to another fix, en route posting rules shall shall be applied as if the FPA had not been exited.

3.6 ALTITUDE PROCESSING

The ODAPS shall process the route of flight with regard to assigned, requested, and adapted altitudes. From input sources, the program shall recognize the altitudes as Field 08 (Assigned Altitude) or Field 09 (Requested Altitude). The program shall determine what altitude to use for processing and the different rules that may be applicable for printing of flight strips, depending on whether the flight plan is active or inactive. Under some conditions, the ODAPS shall use an adapted altitude, that is, an altitude derived from adaptation, instead of the Field 08 or Field 09 entry for processing and printing.

3.6.1 ALTITUDE FORMATS

The ODAPS shall be capable of processing inputs in the following formats to determine fix posting based on the stratification of sectors:

(a) Single altitude;

(b) Blocked altitudes (the highest altitude of the block be used for processing);

(c) Above (ABV) with a suffixed altitude, in which case the suffixed altitude shall be used for processing;

(d) Altitude/Fix/Altitude showing an altitude before and after a fix. Post first altitude up to the fix - Post the fix at all stratums between the first and the second altitude - After the post at the second altitude.

3.6.2 DEPARTURES

A departure flight is one that is filed with a P or D-time, and with the departure fix as the Coordination Fix (Field 06), under the condition that VFR, DVFR, or the tailoring symbol is not the second element. The following rules apply to proposed departures, activation messages, and external departures.

3.6.2.1 PROPOSED DEPARTURES

The ODAPS shall ensure that a flight plan with a proposed departure has an altitude entered for Field 09 which shall be used for processing except when adaptation specifies otherwise or when nonadapted departure processing applies, or both.

3.6.2.2 ACTIVATION MESSAGES

Altitude processing rules for flight activation messages shall include, but not be limited to the following: When a Departure (DM) message or an Amendment (AM) message with a D-time is received activating a flight, and when the activation message does not contain a Field 08, Field 09 of the referent proposed flight plan shall be used for processing. When an activation message contains both a Field 08 and Field 09, processing shall be performed on whichever is the higher. When the Field 08 altitude is lower than the Field 09 altitude, both altitudes shall be retained for strip printing and the flight shall be processed at the Field 09 altitude.

3.6.3 OTHER FLIGHT PLANS

Altitude processing shall also be performed on airfiled flight plans plans and flight plan messages received from adjacent centers. An airfile is a flight plan which is not a departure or an external departure. An airfile shall be altitude processed in a manner similar to activations. The altitude used for processing an inbound flight from an adjacent center shall be the altitude received on the intercenter message.

3.6.4 AMENDMENTS

An en route altitude amendment to an active flight plan shall cause reprocessing, when appropriate. When reprocessed, all FPAs between the old and new altitudes, at the point of altitude transition (flight plan present position fix) shall be converted for potential posting. All fixes behind the flight plan present position fix shall be discarded. An amendment to Field 09 of an active flight plan shall not be allowed.

3.6.5 TRANSITIONS

Route conversion shall ensure that when an altitude transition occurs, all FPAS that overlie the fix at which the transition occurs and that are within the range of transition, are considered for potential posting. Altitude transitions occur as a result of:

(a) Altitude amendments;

(b) Altitude/fix/altitude in Field 08 at the specified fix;

(c) Nonadapted departures;

(d) External departure/arrivals.

4.0 FLIGHT DATA PROCESSING

4.1 PROCESSING DESCRIPTION

The flight data processing functions shall be patterned after the flight data processing functions performed by the En Route 9020 System. Wherever possible the message types, formats, field defination, flight strip generation and pointing, error checking and acceptance checking shall emulate the 9020 System. NAS-MDs (CPFS MD-310 through 316 and 326) shall be referred to by the contractor for additional description, details and clarification. Where this specification differs from the NAS-9020 documentation, these changes will be defined in this specification. NAS message types and field definitions that apply to the ODAPS system are identified in Section 3.3. This section also contains the maximum message size (by device) error checking, eligibility check and legality determination. A comprehensive data base will be created maintained and/or terminated by the input of the various flight data messages. These messages shall be able to be entered into the system from the various positions within the ODAPS facility and from identified external locations or devices. See Section 7.0 for interface description. Primary processing of flight plan data consists of flight plan acceptance, route conversion, calculation of fix arrival (estimate) times, and flight plan extrapolation. Generation of output messages in the form of flight progress strips and/or information update messages is time dependent on the occurance of an event. Time dependency refers to printing of flight progress strips based on status and position of the aircrafts flight plan and certain parameters. Event dependancy refers primarily to modification of data for a particular flight, resulting in generation of update messages or the reprinting of flight progress strips.

4.2 MESSAGES, INPUT AND OUTPUT

The messages described in this section shall be used to establish and maintain the flight plan data base and other related and supportive data information. The status (active or proposed) of each flight plan shall be indicated upon acceptance of each flight plan by the program. Status is determined by the type of coordination time (Field 7) entered as follows:

ACTIVE: When the coordination time is an actual time (D) or an estimated time (E).

PROPOSED: When the coordination time is a proposed time (P) or a flush time (F).

Each individual message used in establishing and maintaining these data bases are described in the following paragraph as to purpose, input source, content (Fields), acceptance checking, processing logic, output and/or results.

The purpose of a flight plan message is to present an oceanic sector controller with pertinent flight information on a flight that enters his airspace.

(a) Input messages include the following:

(1) FLIGHT PLAN: With respect to initial input, the oceanic system will accept up to 650 flight plans in either ICAO or domestic (Stage A)/ resident format. In the exchange of flight plan data with domestic/ resident ATC systems, the format utilized will be Stage A. In the exchange of flight plan data with the ATC system of a foreign state, the format utilized will be as negotiated with that state.

(2) AMENDMENT MESSAGE: In the exchange of flight plan data with the ATC system of a foreign state, the format utilized will be as negotiated with that state.

(3) PROGRESS REPORT: This message shall be expanded to accommodate the position report (AIREP) message. The Progress Report (PR) message shall be used to update the status of an active flight plan or to release a flight plan from a prior hold condition. The PR is a critical message and it shall be modified from what is found in NAS-MD-311, 2.11. The Progress Report message shall be used for and in display of aircraft position data. The modification shall consist of adding position, time of report, altitude, next fix, next fix estimate and subsequent fix to the content of the PR message. Additionally the capability shall be provided to extract AIREP temperature and winds aloft from the PR message for input to the ODAPS winds aloft data base. The ODAPS shall have the capability to receive and process on-line input of the Progress Report from ARINC.

(4) FLIGHT PLAN READOUT:

(5) WINDS ALOFT MESSAGE:

(6) WINDS ALOFT READOUT REQUEST MESSAGE:

(7) STRIP REQUEST MESSAGE:

(8) HOLD/DELAY MESSAGE:

(9) CANCEL FLIGHT PLAN MESSAGE:

(10) CORRECTION CAPABILITY:

(11) /OK (ELIGIBILITY OVERRIDE):

(12) PROBE ANALYSIS MESSAGES: See paragraph 6.0 for probe analysis messages.

(13) PROGRESS REPORT VALIDATION MESSAGE:

(b) Output messages include the following:

(1) FLIGHT PROGRESS STRIPS: Accommodate the position report (AIREP) message from ARINC.

(2) READOUT OF FLIGHT PLANS:

(3) READOUT OF STORED WINDS ALOFT:

(4) ACCEPTANCE AND ERROR DIAGNOSTIC MESSAGE TO CONTROLLER INPUTS:

(5) PROBE ANALYSIS MESSAGES: See paragraph 6.0 for probe analysis messages.

(6) FLIGHT PLAN DATA UPDATE MESSAGES:

(7) PROGRESS REPORT:

(8) PROGRESS REPORT DISCREPANCY MESSAGE: This message shall be generated under the following conditions:

(a) Time variance.

(b) Altitude variance.

(c) Fix variance.

The entire progress report excluding any weather data shall be presented followed by a repeat of the data that is suspected.

(9) PROGRESS REPORT OVERDUE ALERT: This alert shall be generated when a Progress Report message has not been received within a parameter time after the flight was estimated at a posted fix.

(4) FLIGHT PLAN READOUT:

(5) WINDS ALOFT MESSAGE:

(6) WINDS ALOFT READOUT REQUEST MESSAGE:

(7) STRIP REQUEST MESSAGE:

(8) HOLD/DELAY MESSAGE:

(9) CANCEL FLIGHT PLAN MESSAGE:

(10) CORRECTION CAPABILITY:

(11) /OK (ELIGIBILITY OVERRIDE):

(12) PROBE ANALYSIS MESSAGES: See paragraph 6.0 for probe analysis messages.

(13) PROGRESS REPORT VALIDATION MESSAGE:

(b) Output messages include the following:

(1) FLIGHT PROGRESS STRIPS: Accommodate the position report (AIREP) message from ARINC.

(2) READOUT OF FLIGHT PLANS:

(3) READOUT OF STORED WINDS ALOFT:

(4) ACCEPTANCE AND ERROR DIAGNOSTIC MESSAGE TO CONTROLLER INPUTS:

(5) PROBE ANALYSIS MESSAGES: See paragraph 6.0 for probe analysis messages.

(6) FLIGHT PLAN DATA UPDATE MESSAGES:

(7) PROGRESS REPORT:

(8) PROGRESS REPORT DISCREPANCY MESSAGE: This message shall be generated under the following conditions:

(a) Time variance.

(b) Altitude variance.

(c) Fix variance.

The entire progress report excluding any weather data shall be presented followed by a repeat of the data that is suspected.

(9) PROGRESS REPORT OVERDUE ALERT: This alert shall be generated when a Progress Report message has not been received within a parameter time after the flight was estimated at a posted fix.

4.2.1.3.2 REFERENCE FIELD (12)

This field is used for the identification of the field to be amended by the AM message. The field is identified by either the field number or a field abbreviation, as shown in Table I. There may be multiple entries of Field 12 and Field 17 entered in a single AM message, when more than one field is to be amended. A check shall be made to assure that each entered Field 12 is different. When Field 02 is amended, the ODAPS shall not allow other fields in the same message to be amended. Further, once a Field 02 amendment has been applied, no other messages shall be accepted for this flight until all resulting update messages are acknowledged or have been printed on the flight strip printers. Refer to NAS-MD-311, 2.1.3.1.2 and 2.1.3.2.3 for further details.

4.2.1.3.3 AMENDMENT OR CORRECTION FIELD (17)

This field shall totally replace the contents of the Reference Field (12) in the referent stored flight plan, except for a Field 10 (Route) merger. Field 17 shall not be format checked because the data will be checked when the amended flight plan is reprocessed (except when Fields 04 or 07 are replaced). In some cases however, some additional logic checks shall be made. There shall be restrictions as to what,and how, amendments are made in order to preserve the integrity of the flight plan and assure its compatibility with the data base. Checks on Field 10 (Route) shall be particularly comprehensive to ensure that the amended portion of the route can be successfully merged with the original route, thus producing a valid amended route. Error messages shall, in so far as possible, indicate the nature and location of the error. A route readout request shall be trans-mitted to the source as a result of an ambiguity error in an attempted route amendment or a route readout request message (which is an AM message with Field 02 only). A route readout request consists of the filed elements, including any program inserted route elements, identified by sequence number. Field 11 (Remarks) shall be processed on an element basis, the elements being identified by the overcast weather symbol used for intercenter remarks and the clear weather symbol used for intracenter remarks. For further details, refer to NAS-MD-311, 2.1.3.1.3 and 2.1.3.2.4.

4.2.1.4 PROCESSING LOGIC

After input checking is complete, the amended flight plan shall be repro-cessed, when required. Reprocessing is required when any of the following are amended; Field 03, when the aircraft class changes; Field 06; Field 10, with some exceptions; and Fields 08 or 09 in some cases (NAS-MD-311, 2.1.4). The fix times shall be recalculated when the flight plan route is reprocessed when there are any changes in Fields 05, 07 or 08, or a change made to Field 10 involves a delay.

4.2.1.5 OUTPUTS

When an amendment changes the content of flight progess strips or deletes the requirement for strips at a sector or remote FDIO locations, updates or new strips shall be output, excluding updates to the center sector that entered the amendment. When new strips are not required, then the update information shall be transmitted to the (FDIO) CRT at the appropriate sector. All amended flight plans shall be printed on the line printer. As applicable, messages shall be sent to the adjacent centers when the flight plans have already been trans-mitted. When a flight is not going to enter an adjacent center which has received tranmission of a flight plan, then the RS (Remove Strip) message shall be transmitted. Messages to NADIN shall be transmitted as required. Refer to NAS-MD-314, where appropriate, for further details of the results of outputs. Refer to NAS-MD-311, 2.1.5 for further details.

4.2.2 CM, CR (CORRECTION MESSAGES)

These messages are used in response to error messages produced by the computer. CM (Correction Message) pertains to remote TTY unit or units. CR (Correction Message pertains to internal IOT unit or units. See NAS-MD-311, 1.8 for details.

4.2.2.1 SOURCES

The CM message can originate from TTY, and a CR message from an IOT, a keyboard or FDIO.

4.2.2.2 CONTENT

The CM message consists of Field 00 (Source Identification), Field 01 (Message Type), Field 17 (Amendment or Correction Data). The CR message consists of Field 00 (Source Identification). Field 01 (Message Type) Field 25 (Referent Message Descriptions), Field 17 (Amendment or Corrections Data).

4.2.2.3 ACCEPTANCE CHECKING

The logic and format checks outlined in 3.3 shall apply. If Field 00 of a CM message or Field 25 of CR message is not the same source identification an the message to be corrected, the correction message is rejected. See NAS-MD-311-1.8.2 for additional details.

4.2.2.4 PROCESSING LOGIC

Processing shall allow a field or element error to be verified, deleted or replaced, or an omitted field added by the source.

4.2.2.5 OUTPUTS

After a correction is accepted, the referent message shall be processed as an initial message and an appropriate response returned to the entering device.

4.2.3 DEP (ICAO DEPARTURE)

A DEP message is used to activate a proposed departure or a proposed airfile flight plan.

4.2.3.1 SOURCE

From non-U.S. air traffic facilities via AFTN or NADIN.

4.2.3.2 Content

The ICAO DEP message contains a Message Type Field, (01) an Aircraft Identification Field (02), and a Departure Time Field.

4.2.3.3 INPUT CHECKING AND PROCESSING

The checks specified in 3.3, as applicable to the ICAO format shall be performed. Conversion of the message shall: translate the 3 character ICAO message type (DEP) into the 2 character field DM and place it in Field 01, place the 2 to 7 character ICAO Aircraft Identification Field directly into Field 02, and place the Departure Time Field directly into Field 07 of the ODAPS flight data processor message. Reference NAS-MD-311, Appendix H.

4.2.3.4 OUTPUT

The output shall be a DM message.

4.2.4 DM (DEPARTURE MESSAGE)

A departure message is used to activate a flight plan with a proposed departure time. Further details on DM processing are contained in NAS-MD-311, 2.5

4.2.4.1 SOURCES

This message can originate from a keyboard, IOT, or FDIO, or 9020 CCC.

4.2.4.2 CONTENT

DM consists of Field 01 (Message Type), Field 02 (Flight Identification), Field 07 (Coordination Time, optional) and Field 08 (Assigned Altitude, optional).

4.2.4.3 INPUT CHECKING

The checks specified in 3.3 shall be performed. The message shall be checked to ensure that the contents of the data fields agree with the existing data contained in the flight plan to which the departure message is applied. When the data fields do not agree an error message shall be returned. The Field 02 format requirements are the same as those described for the Amendment Message. The data entered may be a computer identification number, Beacon Code, or aircraft identification. When a Field 02 amendment has been applied, no DM messages shall be accepted for this flight until all update messages are acknowledged or have been printed on the associated flight strip printer. Reference NAS-MD-311, 2.5.2 and 2.5.3 for further details on input checking.

4.2.4.4 PROCESSING LOGIC

The proposed time and the stored flight plan shall be changed to the actual departure time, and the estimated time of arrival (ETA) updated as appropriate. The assigned altitude field in the flight plan shall be updated. The flight plan route shall be converted, fix times calculated, and flight progress strips generated. Departure strips shall be generated, when appropriate. Refer to NAS-MD-311, 2.5.4 for further details.

4.2.4.5 OUTPUTS

Flight strips for the Activated Flight Plan shall be printed. Responses shall be sent to the source for DM messages as required. A flight plan printout shall be generated and routed to the line printer. Refer to NAS-MD-311, 2.3.5 for further details.

4.2.5 FP (FLIGHT PLAN)

The purpose of the flight plan message is to establish a data base of active and proposed flight plans used for the printing of flight strips, display, printout, and interfacility data transfer functions. This data base shall also be used by other program functions. Details of FP message processing are contained in NAS-MD-311, 2.7.

4.2.5.1 SOURCES

The sources can be a keyboard, FDIO, an IOT, or 9020 CCC.

4.2.5.2 CONTENT

The content consists of Field 00 (Source Identification from all external sources), Field 01 (Message Type), Field 02 (Flight Identification), Field 03 (Aircraft Data), Field 04 (Beacon Code, optional), Field 05 (Speed), Field 06 (Departure Point/Coordination Fix), Field 07 (Proposed Time/Coordination Time), Field **08** (Assigned Altitude, when the flight plan is active), Field 09 (Requested Altitude, when the flight plan is proposed), Field 10 (Route) and Field 11 (Remarks, optional).

4.2.5.3 INPUT CHECKING

The checks specified in 3.3 shall be performed. Checks shall be performed to ensure that data entered in one field logically agree with data of other fields, and that there is no conflict with the stored data base. Table 2-l in NAS-MD-311 shows the proper data fields and sequence for the different sources. A duplication check shall be performed to determine when a flight plan having the same aircraft identification as contained in the entered message already exists in the stored data base; in this case, an appropriate message shall be transmitted to the source with an accept message, reject message or error message depending on the status of the flight plan and its departure point. Table 2-2 in NAS-MD-311 shows the proper response to the various combinations of status and departure points.

The Coordination Time field (Field **07)** can contain a letter with four numbers, the numbers indicating the time in hours and minutes, and the letter being a D for actual departure time, E for estimated time, F for “flush time”, or P for proposed departure time. The letter F is acceptable only from NAS. Reasonability checks shall be performed on the time within site parameter limits. Refer to NAS-MD-311, 2.7.3.1.6, and Appendix E for further details on Field 07 input checking. Field **08** (Assigned Altitude) shall be required in active flight plan messages. It may indicate an altitude or altitude block (two altitudes separated by the letter **"B"** e.g., **350B370**, defining the upper and lower limits). See NAS-MD-311, **2.7.3.1.7** for format details.

Field 09 (Requested Altitude) shall be required in a proposed flight plan message. It may be an altitude or an altitude block.

Field 10 (Route) input checks are described in Section 3.3.

Field 11 (Remarks) is optional and may contain a maximum of 20 characters (intracenter) or 40 characters (intercenter). The intercenter remarks element shall be identified by a clear weather symbol (0) preceding it. The **intra**-center remarks element shall be identified by an overcast symbol (+) preceding it. Intracenter remarks shall not be transmitted beyond the originating center (NAS-MD-311, **2.7.3.1.10**)

4.2.5.4 PROCESSING LOGIC

The heavy-jet indicator (H) shall be printed on all strips and included in U.S. intracenter transmissions of the flight plan when it has been input in Field 03 (Aircraft Data). When Field 05 (Speed) is entered in the form of a MACH number, it shall be converted to true air speed as defined in NAS-MD-311, 2.7.4.2. The altitude (Field 08 or Field 09) shall be processed and printed on strips as appropriate. Field 10 (Route) processing shall be as defined herein. A computer identification number shall be program assigned to each flight plan. The times of arrival for converted fixes shall be calculated for active flight plans.

4.2.5.5 OUTPUTS

An acceptance, rejection or error message shall be returned to the local source (keyboards, IOT) except as specified herein. A DA message (Acceptance Message) shall be transmitted in response to the receipt of a valid flight plan message. A rejection (DR) message shall be transmitted in response to the receipt of a flight plan message containing a logic error in any field or in the first route segment of Field 10. A retransmit message (DX) shall be transmitted in response to the receipt of a flight plan message in which a transmission error or a format error is detected. When a Field 10 error is detected in any other than the first route segment, the flight plan shall be accepted and a DA message transmitted. In this case, an incomplete route alert shall be output to the sector whose area contains the last posted fix. Flight strips shall be generated and routed as specified herein. Flight plan messages shall be transmitted to other facilities when the aircraft is going to pass into the other facilities. Intracenter remarks in Field 11 shall not be transmitted to another facility. All transmissions to an adjacent facility shall be based on site parameter time. The processing of a flight plan entered with an incomplete route indicator or improper route data shall be performed, provided that at least the first route segment is acceptable and can be converted. In this case, flight progress strips shall be printed for the acceptable portion of the route and an incomplete route indicator (XXX) printed after the last acceptable route element in the route portion of the flight progress strips. When a route amendment is not entered correcting or completing the unacceptable or missing route data within a predetermined time prior to the flights reaching the last posted fix (see NAS-MD-311), an alert shall be output to the sector or sectors posting this last fix (output described in NAS-MD-314). See NAS-MD-314 for formats for flight plan data printout and flight plan summary printout.

4.2.6 FPL (ICAO FLIGHT PLAN)

An FPL message is used to input an ICAO flight plan to the ODAPS data base.

4.2.6.1 SOURCE

Via AFTN or from a non-U.S. air traffic control facility.

4.2.6.2 CONTENT

FPL messages received will consist of the following ICAO fields: Message Type, Aircraft Identification, Flight Rules and Status, Number and Type of Aircraft, Equipment, Departure and FIR Boundaries, Route, Destination and Alternate, and Other Information.

4.2.6.3 INPUT CHECKING AND PROCESSING

The checks specified in 3.3.1.4 and 3.3.1.5 shall be performed, as applicable to the ICAO format. The ICAO message fields shall be translated and placed in the FP message fields as specified in NAS-MD-311, Appendix H.

4.2.6.4 OUTPUT

An FP message. The processing of an FP message deriving from an FPL message shall be as described under 4.2.5.

4.2.7 FR (FLIGHT PLAN READOUT REQUEST)

This message is used to request a display for printout of the specified flight plan.

4.2.7.1 SOURCES

The allowable sources are a keyboard, IOT or FDIO.

4.2.7.2 CONTENT

The message consists of Field 01 (Message Type), Field 02 (Flight Identification) and Field 16 (Output Routing, optional, keyboard only).

4.2.7.3 INPUT CHECKING

The checks specified in 3.3 shall be performed. A check shall be performed to assure that the optional departure point and Field 02 matches the first route element of Field 10 (Route) of the referent flight plan. When more than one flight plan is found with the same flight identification, a list shall be transmitted to the source containing data about each flight plan.

4.2.7.4 PROCESSING AND OUTPUTS

An acceptable input shall result in the display or printout of the filed flight plan. All program-inserted additions shall be included in the output with no elements truncated. When the message is entered from an IOT, the output shall be printed on that IOT. When it is entered from a keyboard and contains the Output Routing field (Field 16), the output shall be printed on the flight strip printer associated with the entering keyboard. When Field 16 is not included in a keyboard input, the response shall be on the associated CRT.

4.2.8 HM (HOLD)

The Hold Message is used to initiate, modify, terminate or cancel a hold action at a converted fix or at the present aircraft position as determined from the flight plan.

4.2.8.1 SOURCES

The sources can be a keyboard, IOT, or 9020 CCC.

4.2.8.2 CONTENT

The content consists of Field 00 (Source Identification, NAS only), Field 01 (Message Type), Field 02 (Flight Identification) and Field 21 (Hold Data).

4.2.8.3 INPUT CHECKING

The checks specified in 3.3 shall be performed. When an aircraft identification is entered, a check shall be performed to ensure this identification uniquely matches the identification of a flight plan currently residing in storage. The departure point, when included within the flight identification shall be checked to see that it matches the first element of Field 10 (Route) of the referent flight plan. When a match does not occur, an error message shall be returned to the source. When the identification matches more than one flight plan, a list of duplicate flights shall be returned to the source.

4.2.8.4 PROCESSING LOGIC

Processing to determine the hold fix and other necessary factors shall be performed as defined in NAS-MD-311, 2.8.4 in so far as it applies to the ODAPS.

4.2.8.5 OUTPUTS

Strips shall be printed as defined in NAS-MD-311, 2.8.5 and the Hold List (defined in Paragraph 5.6) shall be modified.

4.2.9 MP (MISSION FLIGHT PLAN)

This message is used to enter mission flight plan data and to terminate the printing of strips for previously entered mission flight plans. Refer to NAS-MD-311, 2.9 for details of MP message processing.

4.2.9.1 SOURCES

The sources can be card reader, keyboard, (CF)2, or IOT.

4.2.9.2 CONTENT

The content consists of Field 01 (Message Type), Field 22 (Mission Data), Field 02 (Flight Identification), Field 03 (Aircraft Data), Field 05 (Speed), Field 06 (Coordination Fix), Field 07 (Coordination Time), Field 08 (Assigned Altitude), Field 10 (Route) and Field 11 (Remarks, optional). A message to terminate the printing of strips consists of Field 1 and 02 only. Field 22, indicates where, and how many, sets of this mission flight plan are to be printed.

4.2.9.3 INPUT CHECKING

The checks specified in 3.3 shall be performed. Fields 02, 03, 05, 06, 07, 08, and 11 shall be checked in a similar manner or identically to FP (Flight Plan) message checking. Reasonability checks shall be per-formed on all fields. No check shall be made on Fields 03 and 07. Field 22 shall be checked to ensure that it refers to a valid device and has a non-zero number. Duplication checks for Field 02 shall not be performed. When an MP message terminating printing is entered, Field 02 shall be checked to ensure it matches the aircraft identification of a mission flight plan already in storage; otherwise, an error message shall be returned.

4.2.9.4 PROCESSING LOGIC

When the mission flight plan contains 9 or 10 fields, it shall be stored and the outputting of strips shall be initiated, but the flight plan shall not be made a part of the flight plan data base. A mission flight plan containing only Fields 01 and 02 terminates strip printing for all mission flight plans containing the entered AID (Field 02). Upon comple-tion or termination of strip printing, the flight plan shall be deleted from storage and not included in the facility traffic count.

4.2.9.5 OUTPUTS

All flight progress strips generated for a mission flight plan shall be printed on the printer specified in Field 22 in a continuous sequence as specified in NAS-MD-314. The current status of combined FPAs shall be used in the determination of posting. Accept responses shall be returned to the source for IOT and keyboard inputs or to the line printer for card reader inputs.

4.2.10 PR (PROGRESS REPORT)

A Progress Report message is used to update the status of an active flight plan or to release a flight plan from a prior hold action. Details of PR message processing can be found in NAS-MD-311, 2.11. The NAS Progress Report message shall require modification in order to accept the complete Oceanic Progress Report. The modification shall consist of adding altitude, next fix, next fix estimate, and subsequent fix, to the content of the PR message. Additionally there shall be optional fields of temperature and winds aloft data for input to the winds aloft data base.

4.2.10.1 SOURCES

The message can originate from a keyboard, ARINC, IOT, or FDIO.

4.2.10.2 CONTENT

The message consists of Field 01 (Message Type), Field 02 (Flight Identification), Field 54 (Reported Altitude), and optional fields, Field 18 (Progress Report), Field 68 (Fix), and Field 20 (Upper Wind Data).

4.2.10.3 INPUT CHECKING

The checks specified in 3.3 shall be performed. Field 02 shall be checked as in the flight plan message. When an amendment to Field 02 has been input, no PR messages shall be accepted until all update messages have been acknowledged or have been printed on the associated flight strip printer. When a fix is entered in Field 18, it shall be checked to assure that it is adapted and does not occur more than once in the route; when it does, an error message shall be output to an adapted device. In addition to the requirements for eligibility to enter progress reports due to source position or current flight plan status as outlined in NAS-MD-311, 2.11.3.2.3 and 2.11.3.2.4, input checking of the PR will conform to requirements outlined in paragrsaph 4.2.16 above. Input checking has to conform and operate in parallel to the input message.

4.2.10.4 PROCESSING LOGIC

The entered time shall replace the CTA (Calculated Time of Arrival) for the converted fix specified in the progress report message. The CTAs for all converted fixes succeeding the entered fix for the referent flight plan shall be recalculated in relation to the new CTA for the fix entered in the progress report. When the aircraft is in, or is scheduled to be in, hold status, the progress report shall have the effect described in NAS-MD-311, 2.11.4.2. When the message releases a flight from an indefinite hold, strip printing shall be reinitiated in accordance with NAS-MD-314. In conjunction with the requirement contained in paragraph 4.2.(a) (13) above, a Progress Reprort message validation scheme shall be provided whereby if the reported data is found to be questionable by the program (Fix Time differs by a parameter time or other data is not as expected) the controller shall review the progress report before it is applied as an update to the ODAPS flight data processor.

4.2.10.5 OUTPUTS

A message containing the aircraft identification, fix, fix time, altitude, next fix, next fix estimate and subsequent fix shall be sent to the controlling sector for all acceptable Progess Reports. If the Progress Report is unacceptable a Progress Report Validation message shall be output at the controlling sector for validation (SEE 4.2.11).

4.2.11 PV (PROGRESS REPORT VALIDATION MESSAGE)

The PV message provides the range of responses to a Progress Report Discrepancy message which has identified one of following problems with a received progress report.

(a) The reported time by the fix differ's more than a parameter time from the expected time.

(b) The reported altitude differs from the assigned altitude.

(c) The next fix differs from the expected fix.

(d) The estimate for the next fix differs from the CTA for that fix by more than a parameter value.

(e) The subsequent fix differs from the expected fix.

4.2.11.1 SOURCES

The source can be a keyboard or FDIO.

4.2.11.2 CONTENT

The message consists of Field 01 (Message Type), Field 02 (Flight Identification), and optionally, Field 17 (Amendment or Correction Data).

4.2.11.3 INPUT CHECKING

The checks specified in 3.3 shall be performed. If optional Field 17 data is included, it must be of the format and content to reasonably replace the suspect data reported in the PR Discrepancy message, or it should be in the format of a route amendment.

4.2.11.4 PROCESSING LOGIC

If the PV message does not contain optional data, it conveys that the PR is valid as received, i.e., that the suspect data is good. If optional data is included, it should either replace totally the suspect data called out in the Discrepancy message, or be an acceptable route amendment that will resolve the situation wherein a fix has been identified as the suspect data. If the data is altitude data other than stored, an altitude amendment is effected. If it was the fix time, the PV message effects a time revision.

4.2.11.5 OUTPUTS

If optional data is entered, a corresponding amendment and update is generated. In all cases, a positive disposition of the PR will be made.

4.2.12 RS (REMOVE STRIP)

The purpose of the remove strip message is to remove from the ODAPS flight data processor all flight data for an entered flight plan. Details on RS message processing are contained in NAS-MD-311, 2.14.

4.2.12.1 SOURCES

The source can be a keyboard, IOT, FDIO or 9020 CCC.

4.2.12.2 CONTENT

The content consists of Field 00 (Source Identification, used for NADIN), Field 01 (Message Type) and Field 02 (Flight Identification).

4.2.12.3 INPUT CHECKING

The checks specified in 3.3 shall be performed. Further input checking shall be performed as defined in NAS-MD-311, 2.14.3.

4.2.12.4 PROCESSING LOGIC

Refer to NAS-MD-311, 2.14.4 for details on processing.

4.2.12.5 OUTPUTS

A remove strip update message (see NAS-MD-314) shall be routed to all sectors currently posting the flight, starting with the sector containing the flight plan present position, excluding the source that entered the RS message. When the RS message is entered after an interfacility flight plan has been transmitted, a remove strip message shall be sent to the affected facilities (see NAS-MD-315). A Remove Strip message shall cause a flight plan data printout message to be generated and routed to the line printer as specified in NAS-MD-314.

4.2.13 SR (STRIP REQUEST)

The SR message is used to request the printing or reprinting, at the desired position, of one flight progress strip for a specified flight. Details on SR message processing are located in NAS-MD-311, 5.6.

4.2.13.1 SOURCES

The source can be an IOT, keyboard, or FDIO.

4.2.13.2 CONTENT

The message consists of Field 01 (Message Type), Field 02 (Flight Identification), Field 13 (Location Identifier) and Field 16 (Output Routing). Field 02 can be an aircraft identification and departure point, or a computer identification number (CID). Field 13 can be a fix identifier, a fix-radial-distance, or a strip number. Field 16 can be a sector identification or an identification of a facility and, when adapted, a particular flight strip printer.

4.2.13.3 INPUT CHECKING AND PROCESSING

The checks specified in 3.3.1.4 and 3.3.1.5 shall be performed. When a computer identification number is entered in Field 02, it must currently be assigned to a flight plan resident in core storage and an entered aircraft identification must uniquely match the identification of a flight plan in core storage; otherwise, an error message shall be returned. When the optional departure point is included, it must match the first route element of Field 10 for the stored flight plan. The output routing field, Field 16, shall be checked to see that it contains the adapted identification of one of the following: active sector, adapted oceanic FDIO equipment or adjacent center.

4.2.13.4 OUTPUTS

An accept response shall be returned to the entering source. A strip shall be printed in a format determined by the output device to which the strip is routed.

4.2.14 TD (TEST DEVICE)

The TD message is used to provide an output test message isolated from operational messages. Details of TD message processing are contained in NAS-MD-311, 8.5.

4.2.14.1 SOURCES

The source of the message can be a keyboard, IOT, or FDIO.

4.2.14.2 CONTENT

The content consists of Field 00 (Source Identification, NADIN only), Field 01 (Message Type) and Field 16 (Output Routing, optional for keyboards and IOTs). Absence of Field 16 from a message input from a keyboard or IOT indicates that the test message is to be routed to the source.

4.2.14.3 INPUT CHECKING AND PROCESSING

The checks specified in 3.3.1.4 and 3.3.1.5 shall be performed. Field 16 shall be checked to ensure that it is in the proper format. See NAS-MD-311, 8.5.3.1, for additional information.

4.2.13.2 CONTENT

The message consists of Field 01 (Message Type), Field 02 (Flight Identification), Field 13 (Location Identifier) and Field 16 (Output Routing). Field 02 can be an aircraft identification and departure point, or a computer identification number (CID). Field 13 can be a fix identifier, a fix-radial-distance, or a strip number. Field 16 can be a sector identification or an identification of a facility and, when adapted, a particular flight strip printer.

4.2.13.3 INPUT CHECKING AND PROCESSING

The checks specified in 3.3.1.4 and 3.3.1.5 shall be performed. When a computer identification number is entered in Field 02, it must currently be assigned to a flight plan resident in core storage and an entered aircraft identification must uniquely match the identification of a flight plan in core storage; otherwise, an error message shall be returned. When the optional departure point is included, it must match the first route element of Field 10 for the stored flight plan. The output routing field, Field 16, shall be checked to see that it contains the adapted identification of one of the following: active sector, adapted oceanic FDIO equipment or adjacent center.

4.2.13.4 OUTPUTS

An accept response shall be returned to the entering source. A strip shall be printed in a format determined by the output device to which the strip is routed.

4.2.14 TD (TEST DEVICE)

The TD message is used to provide an output test message isolated from operational messages. Details of TD message processing are contained in NAS-MD-311, 8.5.

4.2.14.1 SOURCES

The source of the message can be a keyboard, IOT, or FDIO.

4.2.14.2 CONTENT

The content consists of Field 00 (Source Identification, NADIN only), Field 01 (Message Type) and Field 16 (Output Routing, optional for keyboards and IOTs). Absence of Field 16 from a message input from a keyboard or IOT indicates that the test message is to be routed to the source.

4.2.14.3 INPUT CHECKING AND PROCESSING

The checks specified in 3.3.1.4 and 3.3.1.5 shall be performed. Field 16 shall be checked to ensure that it is in the proper format. See NAS-MD-311, 8.5.3.1, for additional information.

4.3 ROUTE CONVERSION AND FIX POSTING

Route conversion and posting logic differs depending on whether the route to be converted is an adapted route or a direct route. Adapted routes consist of ATS Routes, Composite Routes, Organized Tracks and certain direct routes. Converting an adapted route consists of determining the points of entry and exit from the adapted route and then extracting the converted fix data between the entry and exit points from stored data. Posting the converted fix data depends on how the fix posting priority codes, altitude range data and FPA data associated with each fix on the adapted route have been initialized. Special processing is also provided for coded routes. Five types of coded route options will be provided; these are airspeed, altitude, reentry loop, multiple exit transitions and time delay.

Direct route conversion is applied to each segment of the filed route for which no adapted route applies.

Calculations shall be performed to find the point of intersection between a filed route segment and:

a. A center boundary

b. A Fix Posting Area (FPA) boundary

c. A major or minor airway

d. Lines of latitude and longitude

e. A line perpendicular to that segment which passes through a focal point fix (FPF)

f. A special sector coordination line (S-line)

All points of intersection are stored as converted fixes in the form of x-y coordinates. All points to be posted are normally posted in as the fix only, in the form of latitude/longitude or in the form of fix-radial-distance.

The selection of points to be posted is made according to the following priority list and settings in adaptation, with the result being one posting per pass of the flight through each FPA.

4.3 ROUTE CONVERSION AND FIX POSTING

Route conversion and posting logic differs depending on whether the route to be converted is an adapted route or a direct route. Adapted routes consist of ATS Routes, Composite Routes, Organized Tracks and certain direct routes. Converting an adapted route consists of determining the points of entry and exit from the adapted route and then extracting the converted fix data between the entry and exit points from stored data. Posting the converted fix data depends on how the fix posting priority codes, altitude range data and FPA data associated with each fix on the adapted route have been initialized. Special processing is also provided for coded routes. Five types of coded route options will be provided; these are airspeed, altitude, reentry loop, multiple exit transitions and time delay.

Direct route conversion is applied to each segment of the filed route for which no adapted route applies.

Calculations shall be performed to find the point of intersection between a filed route segment and:

a. A center boundary

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c. A major or minor airway

d. Lines of latitude and longitude

e. A line perpendicular to that segment which passes through a focal point fix (FPF)

f. A special sector coordination line (S-line)

All points of intersection are stored as converted fixes in the form of x-y coordinates. All points to be posted are normally posted in as the fix only, in the form of latitude/longitude or in the form of fix-radial-distance.

The selection of points to be posted is made according to the following priority list and settings in adaptation, with the result being one posting per pass of the flight through each FPA.

4.5.1 FP PAST FIX AND FP NEXT FIX

The converted fixes immediately previous (FP past fix) and subsequent (FP next fix) to the flight plan's present position will be determined.

4.5.2 EXTRAPOLATION STATUS

The current flight plan status (e.g., maneuvering in the vicinity of fix, enroute between fixes, etc.) will be determined. The flight plan past fix and present position are determined before determining extrapolation status. The extrapolation status of a flight plan will be one of the following:

a. NONE - Flight plan is proposed or has not yet reached first converted fix.

b. TURN - Flight is at a fix for which a delay for turning from one segment to another is expected.

c. HOLD - Flight is at a fix for which a hold action has been entered.

d. ENROUTE - The flight is proceeded enroute.

The extrapolation status is determined by flight plan past fix, flight plan present position fix, calculated time of arrival at a fix, present clock time, and the hold fix (if any) for the flight plan.

4.5.3 PRESENT POSITION FIX

The flight plan present position fix will be determined based on calculated times. This determination will identify the fix (past or next fix as determined in 4.5.1) the flight is nearest as the present position fix.

4.6 WINDS ALOFT

An upper wind table (see 10.12 for adaptation criteria) shall be identified in adaptation that contains the wind station identifiers and the altitude for which forecast and/or reported wind data will be stored. These wind data shall be utilized in the calculation of ground speed. See NAS-MD-313, Appendix A for further details.

4.6.1 INPUT/OUTPUT MESSAGES (RESULTS)

4.6.1.1 UW (UPPER WINDS)

The UW message is used to enter wind data for use in fix-time calculation. Refer to NAS-MD-311, 8.7 for details.

4.6.1.2 SOURCES

The sources can be the card reader, IOT, WSMC and from Progress Report. See Section 7 for WSMC criteria.

4.6.1.3 CONTENT

The message consists of Field 01 (Message Type), Field 13 (Location Identifier), Field 19 (Upper Wind Altitude) and Field 20 (Upper Wind Data). Multiple combinations of Field 19 and Field 20 may be entered. Each Field 19 consists of two digits representing thousands of feet. Field 20 contains two digits representing azimuth in tens of degrees (01 to 86), and two digits representing the speed in knots. For speeds from 100 to 195 knots, the azimuth is incremented by the value of 50 (thus ranging from 51 to 86).

4.6.1.4 INPUT CHECKING AND PROCESSING

The checks specified in 3.3 shall be performed. When any of the alti-tudes are not adapted, an error message shall be returned. When the entered reporting station identifier is not an adapted wind reporting station, an error message shall be returned. WSMC wind data that is in error shall be output to an adapted device.

4.6.1.5 RESULTS

When the UW message is in error, a rejection message shall be returned to the entering source and to the line printer for card reader or IOT input. The wind data received via a progress report shall replace previously enter data and stored in the same manner as specified for UN. When it is acceptable, the input data shall be stored as entered and an accept response shall be returned to the source for IOT inputs or to the line printer for card reader inputs. Acknowledgements will not be sent to WSMC. The wind data received via a progress report shall replace previously entered data and be stored in the same manner as specified for UW. If the reported fix does not have an associated wind station or if the altitude is not adapted then the wind data shall be ignored. See 4.2.10.

4.6.2 UR (UPPER WIND REQUEST)

The UR message is used to request a printout of stored upper wind data for the specified reporting station. Details of UR message processing is contained in NAS-MD-311, 5.8.

4.6.2.1 SOURCES

The source can be an IOT or keyboard.

4.6.2.2 CONTENT

UR consists of Field 01 (Message Type) and Field 13 (Location Identifier).

4.6.2.3 INPUT CHECKING

The checks specified in 3.3.1.4 and 3.3.1.5 shall be performed. A check shall be performed to ensure that the entered location identifier (Field 13) is in the adapted Wind Tables; otherwise an error message shall be returned.

4.6.2.4 RESULTS

A printout of stored wind data for all altitudes at the specified station in the format of the input wind data (i.e., altitude/azimuth/speed shall be effected). When complete wind data for the specified station has not been entered since startup, the output format shall consist of the adapted altitudes followed by blanks for any altitudes that have not had azimuth/speed information entered with a UW message.

4.6.3 **POS/AEP (POSITION REPORT/AIREP)**

This message is received on line from ARINC and will be converted for further internal processing as a PR. The wind data from this report shall be utilized to update the wind data tables. (See **4.2.10**)

4.6.3.1 SOURCES

The source will be **AIRINC** or **keyboard/IOT.**

4.6.3.2 CONTENT

The message format must be determined and will be provided within 30 days after contract award.

4.6.3.3 INPUT CHECKING

The checks specified in 3.3 shall be performed. Eligible fields and format shall be provided. If the wind station for the reported fix is not adapted then the wind data of the program report shall be ignored. If the flight reported altitude is not an adapted altitude for the wind station associated with the reported fix the wind data shall be ignored. (See 10.12 for altitudes that can be identified).

4.6.3.4 PROCESSING

Acceptable wind data contained in the Progress Report shall be stored in the Winds Aloft (Upper-Winds) table. See 10.12. The forcast wind data received from WMSC shall be used to establish or update the wind table if:

(a) No data is stored.

(b) Existing data is more than a parameter time old.

The stored data (received via Progress Report or Controller input) shall contain the time of the report. This time shall be used in determining if the forecast winds will replace the currently stored data.

4.7 CONFLICT PROBE SUPPORT

The flight data processing (FDP) function is required to maintain a comprehensive data base to support the conflict probe function. The ODAPS FDP shall perform a check on a flight plan in order to determine if the protected airspace of an aircraft will overlap the protected airspace of any other aircraft within the FIR. This function is termed "conflict probe". Secondly, ODAPS shall be able to display on a Plan View Display (PVD), the current and projected aircraft positions from information derived from the current flight plan data that are resident in the ODAPS FDP data base.

4.7.1 CONFLICT PROBE FUNCTION

The conflict probe function shall consist of determining from flight plan data whether the protected airspace of an aircraft projected along the flight path/profile described by its flight plan will infringe upon (i.e., have points in common with) the protected airspace of any other aircraft or any airspace reservtion. A predicted infringement is termed "potential conflict" of the protected airspaces. The probe shall be executed throughout the ODAPS oceanic adapted airspace traversed by the aircraft. Separation minima described in FAA Handbook 7110.83 shall apply.

4.8 DISPLAY PROCESSING SUPPORT

Flight Data Processing will support the display processing function. This support includes the maintenance of the relevant data base, e.g., current flight plan data for display in tabular lists and in data blocks, and the provision of certain functions, e.g., flight plan position extrapolation, the activation, dropping and sector/center boundary crossing events of flights plans, etc."

4.9 INTERFACE PROCESSING SUPPORT

The operational software program developed by the contractor shall successfully interface with and perform the following functions:

(a) Flight plan data input from PVD keyboards, IOT, 9020 CCCs, and other selected external devices and interfaces.

(b) Up to six (6) enroute 9020 CCCs.

(c) Accept oceanic flight plans and related messages from the 9020 CCC.

(d) Transmit the messages described in this specification to the 9020 CCC.

(e) Output flight plan position data and conflict probe (graphic and alpha-numeric) to situation displays at oceanic sector positions.

(f) Processing of flight plan data and flight data messages received sent to or from non-US ARTCCs, NORAD Facilities, CARF, ARINC, AFTN, and International Flight Service Stations (IFSSs).

(g) Capability of processing flight plan data or the flight data messages received from FDIO equipment located at oceanic sector positions or remote positions.

(h) Output of messages for flight strip printing or flight plan data display, or both, to FDIO terminal equipment at oceanic sector positions or remote positions.

5.0 DISPLAY PROCESSING

The Display Processing function shall drive the situation display. PVDs will be used for the situation displays in ODAPS. There will be a maximum of ten operational PVDs for each ODAPS facility.

5.1 DESCRIPTION

The display shall provide the oceanic controller with a graphic representation of the flight plan extrapolated position of all aircraft under his control. This, along with other alphanumeric data, will provide current spatial relationships and altitude data for decision making. This display shall be capable of displaying time, map data, aircraft position symbols, full data blocks, route displays, velocity vectors and tabular alphanumeric data. An area at the bottom of the display shall be reserved for the review of input messages and for certain computer response messages. Additional display capabilities shall include the blinking of acids in the data blocks of aircraft in conflict as determined by the probe analysis function. The area on the display in which the tabular data is displayed shall be determined independently for each display by site adaptation. The controller shall be provided the capability to relocate tabular data. Most of the display controls presently available with the NAS 9020 PVDs will be used.

Data blocks are addressed in paragraph 5.5, Tabular lists in 5.6, and Maps in 5.4. Further information on the PVD and on Display Processing functions are addressed in the following subparagraphs.

5.1.1 PVD DEVICES

The Plan View Display comes equipped with a number of devices for input, output and filter actions. In terms of these devices, there are two differences between the PVD as configured for ODAPS and the NAS Stage A PVD. ODAPS will not have a Computer Readout Device (CRD), and in the initial version of ODAPS, no utility is made of the Category/Function controls. The physical arrangement of all controls of the PVD is shown in Figure 5.1.

5.1.1.1 DATA ENTRY CONTROLS (DEC)

The DEC interface with the system (i.e., the ODAPS computer) consists of the following devices:

a. Category/Function Controls

b. Quick Action Keys

c. Trackball

d. Alphanumeric Keyboard

5.1.1.2 CATEGORY/FUNCTION CONTROLS

For the initial software version of ODAPS, these controls will not be utilized.

5.1.1.3 QUICK ACTION KEYS

Each PVD has 15 quick action keys. The Message Type Designator (Field 01) for a message shall be entered by means of a Quick Action Key. The PVD has a module of 15 backlighted Quick Action Keys. These keys are locked when a message is entered into the system. They are unlocked when the system acknowledges the message or the CLEAR key is depressed.

The Trackball Enter Key duplicates the function of the Alphanumeric Keyboard for all Quick Actions in which a trackball can be entered. If the Controller wishes to deselect the Quick Action after the Quick Action Key has been depressed, he can do so by pushing the Clear Key, which clears the Preview Area and returns the cursor to the first character position, then reinitiating the input.

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5.1.1.6.1 DISPLAY FILTER KEYS

Twenty-eight Display Filter Keys are arranged in 4 columns with 7 rows. These backlighted alternate action keys are used to select or inhibit the Class/Types of data that are displayed on the PVD. These will include the Map Select function and the Altitude Filter function.

5.1.1.6.2 FIELD SELECT KEYS

An array of eight backlighted alternate action inhibit or select Field Select Keys are physically present. However, only 6 keys are enabled for ODAPS. One key selects or inhibits the Full Data Block Leader. One key selects or inhibits the Full Data Block Position Symbol. The remaining four keys address Fields 3 through 6 of the data block. Fields 1 and 2 cannot be inhibited.

5.1.1.6.3 RANGE CONTROL

A fourteen-position rotary switch provides range (display radius) control. Only the first six range settings (given in nautical miles (nmi) of usable display radius) can be selected by the controllers. Within the maximum range of 2000 miles, these will be site adaptable; nominal setting 100, 250, 500, 1000, 1500 and 2000.

5.1.1.6.4 OFFCENTERING KEYS

Offcentering controls are two backlighted interlocking keys - Preset and Manual. Depression of the Present Key will center the PVD on the preset origin (based on system coordinates) for this console. The preset origin is specified by adaptation at startup.

Manual offcentering is accomplished by positioning the Trackball at the point desired for the new PVD center, then depressing the Manual key.

5.1.1.6.5 FLIGHT PLAN POSITION SYMBOL HISTORY CONTROL

A six-position rotary switch allows selection of 0 to 5 reports of Flight Plan Position Symbol History.

5.1.1.6.6 DATA BLOCK LEADER LENGTH CONTROL

A four-position rotary switch allows the selection of the Leader Length between the track symbol and Data Block character array. The four selectable values are:

a. 0 inches (in.)

b. 0.625 in. (1/32 display diameter)

c. 1.25 in (1/16 display diameter)

d. 2.50 (1/8 display diameter).

5.1.1.6.7 DATA BLOCK VELOCITY VECTOR LENGTH CONTROL

A five-position rotary switch allows the selection of the length of the data block velocity vector. Within the maximum of 180 minutes of flying time, the 5 values will be site adaptable, e.g. 0, 5 20, 60, 180 minutes of flying time.

5.1.1.6.8 MODE KEYS

This row on the console's System Status Control Panel contains one indicator and three backlighted alternate action mode keys. These are:

a. Console Power Indicator (reflects the on and off position of the console power switch)

b. Not Assigned

c. Not Assigned

d. Not Assigned.

The Console Power Key is a lamp indicator which reflects the settings of the console power switches located in the enclosed shelf area.

5.1.1.6.6 DATA BLOCK LEADER LENGTH CONTROL

A four-position rotary switch allows the selection of the Leader Length between the track symbol and Data Block character array. The four selectable values are:

a. 0 inches (in.)

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5.1.1.6.8 MODE KEYS

This row on the console's System Status Control Panel contains one indicator and three backlighted alternate action mode keys. These are:

a. Console Power Indicator (reflects the on and off position of the console power switch)

b. Not Assigned

c. Not Assigned

d. Not Assigned.

The Console Power Key is a lamp indicator which reflects the settings of the console power switches located in the enclosed shelf area.

5.1.4 DATA BLOCK OFFSET

Data blocks shall be offset with respect to the position symbol auto-matically by the display function. The direction of offset will be in accordance with adaptation. The offset direction in individual data blocks will be changeable by controller input message. (See 5.2.6).

5.2 INPUT MESSAGES

This section will deal with those messages specifically relevant to the Display Processing function as identified in the following table:

MESSAGE TYPE	MESSAGE NAME	PARAGRAPH
QX	Drop Track	5.2.1
QP*	Point Out	5.2.2
QP*	Reposition List	5.2.3
QP*	Request/Suppress Data Block	5.2.4
QU	Route Display	5.2.5
QZ	Data Block Offset	5.2.6
CT	Construct/Delete Temporary Airspace Reservation	5.2.7

* The differences in formats will differentiate between actions in a message type.

5.2.1 QX (DROP TRACK ONLY)

This message is used to discontinue the display of the data block while maintaining the flight plan data.

5.2.1.1 SOURCES

This message originiates from the PVD Data Entry Controls (DEC).

5.2.1.2 CONTENT

The message consists of Field 01 - Message Type and Field 02 - Flight Identification.

EXAMPLE: QX TW147

5.2.1.3 INPUT CHECKING AND PROCESSING

The general checks described in 3.3 will apply.

5.2.1.4 PROCESSING AFTER ACCEPTANCE

The generation of the data block is discontinued and the currently displayed data block is dropped.

5.2.1.5 RESULTANT OUTPUTS

All data blocks for this track will be dropped from all PVDs.

5.2.2 QP (POINT OUT)

This action is used to request the display of a data block at another sector's PVD.

5.2.2.1 SOURCES

This message originates from the PVD Data Entry Controls (DEC).

5.2.2.2 CONTENT

The message consists of Field 01 - Message Type, Field 16 - Output Routing (must be a sector within the center), and Field 02 - Flight Identification.

EXAMPLE: QP 35 NW55

5.2.2.3 INPUT CHECKING AND PROCESSING

The general checks described in 3.3 will apply. The sector addressed by this message must have an assigned PVD. A data block cannot be pointed out if the extrapolation status is hold (other than present position).

5.2.2.4 PROCESSING AFTER ACCEPTANCE

If the data block is displayed at the PVD identified by the entered sector number, take no action on the data block as a result of the input message. If the data block is not presently being displayed on the PVD paired to the addressed sector, a data block will be prepared for display.

5.2.2.5 RESULTANT OUTPUTS

A data block will be displayed at the addressed sector.

NOTE: A data block displayed as a result of a point out may be deleted at the sector receiving the point out by a suppress data block action (See 5.2.4).

5.2.1.3 INPUT CHECKING AND PROCESSING

The general checks described in 3.3 will apply.

5.2.1.4 PROCESSING AFTER ACCEPTANCE

The generation of the data block is discontinued and the currently displayed data block is dropped.

5.2.1.5 RESULTANT OUTPUTS

All data blocks for this track will be dropped from all PVDs.

5.2.2 QP (POINT OUT)

This action is used to request the display of a data block at another sector's PVD.

5.2.2.1 SOURCES

This message originates from the PVD Data Entry Controls (DEC).

5.2.2.2 CONTENT

The message consists of Field 01 - Message Type, Field 16 - Output Routing (must be a sector within the center), and Field 02 - Flight Identification.

EXAMPLE: QP 35 NW55

5.2.2.3 INPUT CHECKING AND PROCESSING

The general checks described in 3.3 will apply. The sector addressed by this message must have an assigned PVD. A data block cannot be pointed out if the extrapolation status is hold (other than present position).

5.2.2.4 PROCESSING AFTER ACCEPTANCE

If the data block is displayed at the PVD identified by the entered sector number, take no action on the data block as a result of the input message. If the data block is not presently being displayed on the PVD paired to the addressed sector, a data block will be prepared for display.

5.2.2.5 RESULTANT OUTPUTS

A data block will be displayed at the addressed sector.

NOTE: A data block displayed as a result of a point out may be deleted at the sector receiving the point out by a suppress data block action (See 5.2.4).

5.2.4.2 CONTENT

The message consists of Field 01 - Message Type and Field 02 Flight Identification.

EXAMPLE: QP PA106

5.2.4.3 INPUT CHECKING AND PROCESSING

The general checks described in 3.3 will apply. A request for a data block cannot be honored for an aircraft whose extrapolation status is hold (other than present position).

5.2.4.4 PROCESSING AFTER ACCEPTANCE

If display of the aircraft's data block is being suppressed, this action will cause the data block to be displayed -- and conversely.

5.2.4.5 RESULTANT OUTPUTS

a. If the aircraft's data block is not being displayed at the requesting sector's PVD, route the data block to the requesting sector's PVD without a timeout.

b. If the aircraft's data block is being displayed as a result of above or as a result of a Point Out action in which the sector addressed is the sector taking the Request/Suppress Data Block action, drop the display of the data block at the requesting sector's PVD.

5.2.5 QU (ROUTE DISPLAY)

This action is used to display the portion of the specified aircraft's route from the extrapolated flight plan position to a point which takes place at a parameter number of minutes along the route, or, if requested, to a point which will be met at a specified time interval. In any case the display will not extend beyond the last converted fix for the flight plan. When the action is entered, and the route is already being displayed, the display will be deleted.

5.2.5.1 SOURCES

This message originates from the PVD Data Entry Controls (DEC).

5.2.5.2 CONTENT

The message consists of Field 01 - Message Type, Field 02 - Flight Identification, and Field 49 - Route Display Time.

EXAMPLES: QU BN12

QU BN12 30

5.2.5.3 INPUT CHECKING AND PROCESSING

The general checks described in 3.3 will apply. The aircraft must be active, have a flight plan in core storage, and it must not be in HOLD status.

5.2.5.4 PROCESSING AFTER ACCEPTANCE

a. If no time (Field 49) is entered, the time data will be set equal to an adapted parameter value.

b. Displayed line segments will remain on the requesting PVD for a parameter interval.

c. The requesting sector can enter up to two more Route Display Requests during the time that the first is being displayed. The timeout of the last one displayed will be used to determine display durations for all (i.e., all will be displayed until the last one is timed out).

d. If only Field 01 is entered, the display of all routes currently being displayed will be deleted.

e. If a route display is entered containing only a Field 02 for an aircraft 'whose route is currently being displayed, the display of that route will be deleted.

f. If a field 49 is entered, the portion of the route displayed will be from the present position of the flight plan to the extrapolated position after the entered time parameter.

g. If a Route Display is entered containing both a Field 49 and a Field 02 for an aircraft whose route is currently being displayed, the old Route Display for that flight will be deleted and a new display will be output per paragraph (f) above.

h. When a Route Display is entered for an aircraft whose route is not currently being displayed and if three Route Displays are currently being displayed, the oldest Route Display will be replaced.

5.2.5.3 INPUT CHECKING AND PROCESSING

The general checks described in 3.3 will apply. The aircraft must be active, have a flight plan in core storage, and it must not be in HOLD status.

5.2.5.4 PROCESSING AFTER ACCEPTANCE

a. If no time (Field 49) is entered, the time data will be set equal to an adapted parameter value.

b. Displayed line segments will remain on the requesting PVD for a parameter interval.

c. The requesting sector can enter up to two more Route Display Requests during the time that the first is being displayed. The timeout of the last one displayed will be used to determine display durations for all (i.e., all will be displayed until the last one is timed out).

d. If only Field 01 is entered, the display of all routes currently being displayed will be deleted.

e. If a route display is entered containing only a Field 02 for an aircraft 'whose route is currently being displayed, the display of that route will be deleted.

f. If a field 49 is entered, the portion of the route displayed will be from the present position of the flight plan to the extrapolated position after the entered time parameter.

g. If a Route Display is entered containing both a Field 49 and a Field 02 for an aircraft whose route is currently being displayed, the old Route Display for that flight will be deleted and a new display will be output per paragraph (f) above.

h. When a Route Display is entered for an aircraft whose route is not currently being displayed and if three Route Displays are currently being displayed, the oldest Route Display will be replaced.

5.2.6.4 PROCESSING AFTER ACCEPTANCE

a. The numbers in Offset Direction are to be interpreted as requesting offset directions as follows:

NUMBER	DIRECTION
1	NORTHWEST
2	NORTH
3	NORTHEAST
4	WEST
5	BASED ON TRACK HEADING AT THE TIME OF THE REQUEST
6	EAST
7	SOUTHWEST
8	SOUTH
9	SOUTHEAST

b. The numbers in the Leader Length Element of Field 59 are to be interpreted as requesting leader lengths as follows:

NUMBER	LENGTH
0	0 INCHES
1	1/32 OF THE DISPLAY DIAMETER
2	1/16 OF THE DISPLAY DIAMETER
3	1/8 OF THE DISPLAY DIAMETER
4	THE SETTING SPECIFIED BY THE DEC's DATA BLOCK LEADER LENGTH CONTROL SWITCH (SEE NAS-MD-311, SECTION 1.1.1.3.6)

5.2.6.5 RESULTANT OUTPUTS

The selected aircraft data block shall be respositioned in accordance with the input offset action and will affect only the PVD at the entering sector.

5.2.7 CT (CONSTRUCT/DELETE TEMPORARY AIRSPACE RESERVATION)

This message is used to define or terminate/delete a temporary airspace reservation, both for graphic display on the PVD's and for use in Probe Analysis. The message will include the lateral and vertical limits as well as the effective beginning and ending times of the reservation.

5.2.7.1 SOURCE

This message originates from the PVD Data Entry Controls (DEC) and from the Supervisory Position IOT.

5.2.7.2 CONTENT

The message consists of Field 01 - Message Type, Field 66 - Map Identification*, either Field 65 - Trackball Coordinates or Field 68 Fix (there will be multiple iterations of Field 65 or 68, i.e., at least 2 and no more than 8), Field 08 - Assigned Altitude, and two iterations of Field 67 -Time.

EXAMPLES: CT M32a

CT M32b 3545N/4015W 3650N/3900W 3415N/3900W
310B330 1500 1800

* The Map Identification format to uniquely identify this airspace reservation shall be "M", plus the 2-digit sector ID, and an alpha character.

5.2.7.3. INPUT CHECKING AND PROCESSING

The general checks specified in 3.3 shall apply. If the Map Identification is one previously entered, that airspace reseration will be terminated/deleted. Otherwise, the points defined in the iterations of Field 65 or 68 will be processed as sequential line segments, i.e., Point 1 to Point 2, Point 2 to Point 3, Point 3 to Point 4, etc., such that in total it defines either a series of line segments or circumscribes an area of airspace reservation. If only two points are provided, or if the last segment does not conclude back at Point 1, the reservation is route segment(s) rather than a polygon.

5.2.7.4 PROCESSING AFTER ACCEPTANCE

The data shall be stored as a temporary addition to one of the four maps - as predetermined by adaptation. Thereby, when that map is selected for display, the temporarily defined airspace reservation will also be displayed. The map identification data will also be stored for potential reference in subsequent executions of the Probe Analysis function.

5.2.6.5 RESULTANT OUTPUTS

The selected aircraft data block shall be respositioned in accordance with the input offset action and will affect only the PVD at the entering sector.

5.2.7 CT (CONSTRUCT/DELETE TEMPORARY AIRSPACE RESERVATION)

This message is used to define or terminate/delete a temporary airspace reservation, both for graphic display on the PVD's and for use in Probe Analysis. The message will include the lateral and vertical limits as well as the effective beginning and ending times of the reservation.

5.2.7.1 SOURCE

This message originates from the PVD Data Entry Controls (DEC) and from the Supervisory Position IOT.

5.2.7.2 CONTENT

The message consists of Field 01 - Message Type, Field 66 - Map Identification*, either Field 65 - Trackball Coordinates or Field 68 Fix (there will be multiple iterations of Field 65 or 68, i.e., at least 2 and no more than 8), Field 08 - Assigned Altitude, and two iterations of Field 67 -Time.

EXAMPLES: CT M32a

CT M32b 3545N/4015W 3650N/3900W 3415N/3900W
310B330 1500 1800

* The Map Identification format to uniquely identify this airspace reservation shall be "M", plus the 2-digit sector ID, and an alpha character.

5.2.7.3. INPUT CHECKING AND PROCESSING

The general checks specified in 3.3 shall apply. If the Map Identification is one previously entered, that airspace reseration will be terminated/deleted. Otherwise, the points defined in the iterations of Field 65 or 68 will be processed as sequential line segments, i.e., Point 1 to Point 2, Point 2 to Point 3, Point 3 to Point 4, etc., such that in total it defines either a series of line segments or circumscribes an area of airspace reservation. If only two points are provided, or if the last segment does not conclude back at Point 1, the reservation is route segment(s) rather than a polygon.

5.2.7.4 PROCESSING AFTER ACCEPTANCE

The data shall be stored as a temporary addition to one of the four maps - as predetermined by adaptation. Thereby, when that map is selected for display, the temporarily defined airspace reservation will also be displayed. The map identification data will also be stored for potential reference in subsequent executions of the Probe Analysis function.

5.3.2 PVD OUTPUT RESPONSES

These responses shall be in a form explicity visible on the PVD in reaction to and in accordance with the input message. The specific response to PVD input messages are spelled out in other paragraphs within this section as follows:

DROP TRACK (QX)	5.2.1
REPOSITION LIST (QP)	5.2.3
REQUEST/SUPPRESS DATA BLOCK	5.2.4
ROUTE DISPLAY (QU)	5.2.5
DATA BLOCK OFFSET (QZ)	5.2.6
CONSTRUCT/DELETE TEMPORARY AIRSPACE RESERVATION (CT)	5.2.7

5.4 MAPS

ODAPS shall provide the capability to select for display any area of the airspace map at any of the controller positions. Available at each display will be a minimum of up to four maps of the entire oceanic airspace with identical area coverage but with different features. The controller shall have the capability of selecting any of the four maps individually, or any combination of the four maps simultaneously. For any combination of the four maps the features of the maps shall be mutually superimposed. The maps shall encompass the entire oceanic airspace with an overlap of a minimum of 100 nm into adjacent airspace whether oceanic or non-oceanic. Map data shall include adapted routes, navigational aids, latitude/longitude grid coordinates, fixes, restricted areas, boundaries (including ADIZ boundaries), and other symbols, intersections, and lines needed by the controller. The contents of the individual maps will be site optional through adaptation.

5.4.1 SECTORIZATION

The capability shall be provided for sector reconfiguration (combining and decombining). Changes in mapping scale shall be provided. The capability shall be provided to combine up to a maximum of 4 sectors. When sectors are combined the routes of aircraft involved in a potential conflict shall be displayed to the limits of the display coverage.

5.4.2 AIRSPACE RESERVATION

A display function shall be provided to construct or delete a straight line segment or a polygon not to exceed eight sides, The entry process-ing will accept either latitude/longitude NODES from a keyboard or coordinates described by the trackball. These straight line segments or area enclosed by reserved polygon will be processed as warning areas by the probe function.

5.4.3 MR (MAP REQUEST)

This message is used to provide a specific PVD map for use at a PVD.

5.4.3.1 SOURCES

The source can be an IOT or keyboard.

5.4.3.2 CONTENT

The message consists of Field 01 (Message Type), Field 16 (Output Routing) and Field 66 (Map Identification).

5.4.3.3 INPUT CHECKING

The checks specified in 3.3 apply. The map record specified must exist in ODAPS storage.

5.4.3.4 PROCESSING LOGIC AND OUTPUTS

The requested map record will be displayed at the identified PVD.

5.5 DATA BLOCKS (DBs)

A data block (DB) shall be generated for display in association with the flight plan extrapolated aircraft position symbol. The contents of the data block are described in Paragraph 5.5.1. The location of the data block will be updated with the aircraft position symbol at a parameter interval. (See 5.1.2). The content of the data block shall be updated every 5 minutes in accordance with the latest available flight plan data. The timing of the generation of the data block is identical to that of the flight plan position symbol, i.e., it is initially displayed or dropped simultaneously with the position symbol. For both the data block and the position symbol there shall be a parameter for the following: display prior to entry into the ODAPS's centers airspace; drop from display upon egress from ODAPS center airspace; display on any subsequent sector PVD prior to entry into that sector's airspace, and dropping of the display upon egressing that sector's airspace.

5.4.2 AIRSPACE RESERVATION

A display function shall be provided to construct or delete a straight line segment or a polygon not to exceed eight sides, The entry process-ing will accept either latitude/longitude NODES from a keyboard or coordinates described by the trackball. These straight line segments or area enclosed by reserved polygon will be processed as warning areas by the probe function.

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This message is used to provide a specific PVD map for use at a PVD.

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The source can be an IOT or keyboard.

5.4.3.2 CONTENT

The message consists of Field 01 (Message Type), Field 16 (Output Routing) and Field 66 (Map Identification).

5.4.3.3 INPUT CHECKING

The checks specified in 3.3 apply. The map record specified must exist in ODAPS storage.

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The requested map record will be displayed at the identified PVD.

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5.5.2 UPDATE MESSAGES

If an update message is received at a sector as a result of an action outside the sector and that update shall result in a change to one or more fields of the data block, the change shall be made to the data block only after the update message has been acknowledged.

5.6 TABULAR LISTS

The capability shall be provided to display in tabular lists data on flights for which a Progress Report (PR) has not been received with parameter minutes of the calculated estimate at a reporting point and on flights that are in potential conflict. The area on the PVD in which the two tabular lists are displayed shall be determined independently for each sector by site adaptation. The controller shall be provided the capability to relocate tabular data. (See 5.2.3).

5.6.1 OVERDUE LIST

Data on flights with overdue progress reports shall include the flight identification, fix and fix estimate, and shall be ordered in the list in accordance with occurrence, i.e., the longest overdue flight will be at the top of the list. When a Progess Report is received, that data entry shall be removed from the list.

5.6.2 PROBE ANALYSIS LIST

Data on potential conflicting flights shall be entered in the list as the result of Probe Analysis function whether that function has been triggered automatically or as the result of a manual request. The data shall be ordered from top to bottom in order of generation. Tabular data describing a potential conflict shall remain displayed until either an amendment is received or canceled that removes the potential conflict or the controller enters a Probe Analysis Acknowledgement message. The content of the Probe Analysis List is described in paragraphs under 6.0.

6.0 CONFLICT PROBE ANALYSIS

The objective of conflict probe analysis is to calculate the spatial relationship between a given flight and any other flight or airspace reservation in the system to determine if and when their spacing will be potentially less than the applicable separation minimum and to provide, in a timely manner, definitive information on that spatial relationship to the controller. Capabilities for automatic and manual initiation of conflict probes shall be provided.

6.1 DESCRIPTION

The conflict probe function shall consist of determining from flight plan data whether the protected airspace of an aircraft of an aircraft projected along the flight path/profile described by its flight plan will impinge upon (i.e., have points in common with) the protected airspace of any airspace reservation or any other aircraft flying the route described by its flight plan. A calculated impingement is termed a "potential conflict" of the protected airspaces. The probe shall be executed from the coordination fix prior to entering Oceanic Airspace and the first fix after leaving Oceanic Airspace.Separation minima described in FAA Handbook 7110.83 shall apply.

6.1.1 PROBE ACTIVATION

Conflict probes shall be initiated:

(a) AUTOMATICALLY:

(1) On flight plan activation, i.e., concurrent with the printing of the initial oceanic flight progress strip with an active estimate.

(2) On changes in critical flight plan data:

(a) Any change in altitude

(b) Any change in route wherein the affected route is within the oceanic center's airspace

(c) A change in reported or estimated fix-times, compared with the associated times currently stored, of more than a parameter value

(d) Any change in speed

(3) On a scheduled parameter interval.

(b) MANUALLY:

(1) By the controller initiating a probe, either at the time of request message entry or at a specified time in the future. A conflict probe shall be initiated for proposed or active flight plans by entering the aircraft identification with an appropriate instruction.

6.1.2 SEPARATION FACTORS

For conventional separation, i.e., non-composite separation, an aircraft's protected airspace shall be expressed in terms of four distances (parameters):

(1) The vertical distance above the aircraft, which shall always be the same as the vertical distance below the aircraft, except at flight level (FL) 290. FL 290 shall have 1,000 feet vertical distance above and 500 feet vertical distance below. Above flight level 290 the vertical distance above or below the aircraft shall be 1000 feet. Below flight level 290 the vertical distance shall be 500 feet;

(2) The longitudinal horizontal distance ahead of the aircraft along its flight path;

(3) The longitudinal horizontal distance behind the aircraft along its flight path; and

(4) The lateral horizontal distance from the aircraft (measured perpendicular to the aircraft's flight path), which shall be the same for both sides.

For aircraft operating within a composite route system there is in addition to the above parameters yet another separation factor to be considered. That factor is composite separation. Composite separation is the application between two aircraft of a combination of separation dimensions, i.e., specifically, one-half the vertical minimum and one-half the lateral minimum specified for the area concerned. The distances (separation) shall be adapted in accordance with the values specified in the relevant sections of FAA Handbook 7110.83, Chapter 2 as follows:

(a) Vertical separation - SECTION 2

(b) Longitudinal separation including MACH technique - SECTION 3

(c) Lateral separation - SECTION 4

(d) Composite separation - SECTION 5

The capability shall be provided to add to the longitudinal value a site adapted increment as a "buffer". The buffer is added to allow for controller judgment in those situations where the apparent spacing between flights may be marginally more than the applicable separation minimum. Also, for the application of separation criteria, it shall be possible to divide each oceanic sector, through adaptation, into four subsectors; and, to divide each subsector into three altitude ranges. Thus, it shall be possible to divide the volume of airspace defined by the sector into twelve modules. It shall be possible to adapt independent vertical, longitudinal, lateral and composite separations for each module.

1.1.3 PROBE ANALYSIS FUNCTION

The subject flight shall be projected along its flight path/profile in accordance with its calculated ground speed to determine if its protected airspace overlaps that of any other flight or airspace reservation at co-altitude. Probe analysis data will be provided to the controller as a result of the actions specified in the following subparagraphs and in accordance with Paragraph 6.3.

1.1.3.1 LONGITUDINAL CONSIDERATIONS

In support of the execution of probe analysis, the position of the flight will be extrapolated forward along the route of flight until the route reaches the first fix outside oceanic airspace. The point along the route of flight at which the probe will be initiated and from which the flight plan extrapolated position will be projected forward varies according to the situation as follows:

a. For APREQs (approval requests), the probe shall begin at the calculated oceanic entry point for a proposed departure. (See 6.1.3.4).

b. For manually initiated probe analysis requests that involve a proposed reduction in speed or any change in altitude, the probe shall begin at a point that is the applicable longitudinal minimum, plus an adapted buffer, behind the flight's currently extrapolated position.

c. For all other probes, the point of probe initiation shall be currently extrapolated position.

With respect to the applicable longitudinal minimum to be used, the Mach number technique value will be used in probing against only those flights that are proceeding in the same direction on the same route. Otherwise, the non-Mach value, i.e., "conventional" longitudinal minimum will be used. These normal processing rules may be overriden by specifying in the input message whether Conventional or Mach separation (Field 90 - Longitudinal Separation Indicator) will be used in the execution of the probe function.

6.1.3.2 LEVEL FLIGHTS

(a) If the flight plan route centerline intersects that of a co-altitude flight, potential conflict information will be provided the controller when the difference in the two flight's respective estimates at the point of intersection is less than the sum of: (1) the applicable longitudinal separation minimum, and (2) an additional buffer value (parameter).

(b) If the route center line does not intersect with but approaches that of a co-altitude flight, and if there is less than the sum of the applicable longitudinal separation minimum and an adapted additional buffer between them during the airspace overlap, potential conflict data will be provided if their laterally protected airspaces overlap. No additional buffer airspace will be added to the lateral minimum.

, (c) If the subject flight will overtake or be overtaken by another aircraft at co-altitude on a common or virtually common route, i.e., if the spacing between their extrapolated positions in flight minutes calculated for the overtaking flight is less than the sum of the applicable separation minimum and the specified additional buffer, potential conflict information will be provided to the controller.

(d) If an airspace reservation is composed of one or more route segments, the probe analysis processing will be as applicable in a,b or c above. Otherwise, when the airspace reservation is a polygon, and if the protected airspace of the route overlaps that of an airspace reservation polygon, potential conflict data will be provided. Again, no additional buffer airspace in the lateral dimension will be added.

6.1.3.3 ALTITUDE TRANSITIONING PROBE

When the subject flight is proposing transition through one or more usable altitudes, the probe shall be executed against flights at usable altitudes within the span of altitudes being traversed, to and including the proposed final altitude. Potential conflict data shall be displayed by applying the protected airspace described in this document. Simplified modification of the shape of the protected airspace during altitude changes shall be allowable, subject to the approval of the FAA. For example, when an aircraft is to climb from one cruising altitude to another, it shall be allowable to define the lower limit of the vertically protected airspace as the lower limit before the aircraft starts to climb, and the upper limit as what the upper limit will be after the aircraft has completed its climb. The increased limits of vertically protected airspace shall only be valid while the aircraft is in altitude transition. A site parameter shall be provided to define when the climb or descent is to start, defined in terms of minutes from the time the manually initiated probe analysis request message is entered. A second site parameter shall be provided that defines the climb rate, and a third site parameter shall define the descent rate. Information on potential conflicts will be provided the controller in accordance with Paragraph 6.3.

6.1.3.4 APPROVAL REQUEST PROBE

(a) If the subject's flight plan is a proposed departure, the probe shall be executed against the "final" altitude only, i.e., it shall not probe against the usable altitudes being traversed as is done for a Transitioning Flight.

(b) An internal estimate shall be calculated for the oceanic entry point taking into account the distance from the departure point, nominal climb times, and either the stored proposed departure time, or a "speculative" proposed departure time. The "speculative" proposed departure time will be for probe analysis purposes only, and will be as entered as an optional field in the manually input probe analysis request message. The initial probe of "final" altitude will be against the flight plan requested altitude. If that altitude is not conflict free, additional alternative altitudes selected in accordance with site adapted rules shall be probed for a conflict free altitude. Information on potential conflicts will be provided the controller in accordance with 6.3.

6.1.3.5 TRIAL AMENDMENT PROBE

The capability shall be provided for the entry of a trial amendment to a flight plan, i.e., a proposed change to the altitude, route or speed of the flight. That trial amendment shall be entered in the form of a probe analysis request message which will result in the execution of probe analysis, and the output of data in accordance with 6.3. If a subsequent valid amendment identical to the trial amendment is entered within a parameter time of when the trial message was input; a repetition of the probe analysis will not be necessary.

6.1.4 OUTPUT TO THE PVDs.

If the probe analysis determines that a potential conflict exists, the output shall be a tabular description of the potential conflict, a graphic projection of the route of each affected flight, and the blinking of the data block ACID's of those aircraft. On an automatically initiated probe, the results shall be routed to the PVD of the sector presently having control, or to the first sector that is scheduled to receive control of the subject aircraft. The tabular description of the potential conflict shall be routed to that PVD regardless of the sector coverage displayed at that time. On a manually initiated probe, the results shall be routed to the PVD initiating the probe. When no potential conflict exists, regardless of whether the probe was initiated automatically or manually, a tabular message stating that no potential conflict exists shall be output. The tabular probe analysis results shall remain displayed until the controller enters an acknowledgement message. The route projections and blinking ACID's shall be subject to timeout. Space shall be provided for the simultaneous display of up to three probe analysis messages, and excess probe analysis tabular messages shall be routed to the flight strip printer with appropriate notification to check the printer.

6.2 PROBE ANALYSIS REQUEST/ACKNOWLEDGEMENT MESSAGE (PA)

This message serves either to initiate a conflict probe or as a controller acknowledgment of the displayed results of an earlier probe analysis. If the aircraft identified in the input message is the same as that of graphic and/or tabular outputs currently being displayed as the result of a previous probe analysis, the input message shall serve to acknowledge and to discontinue their display. Otherwise, a conflict probe shall be initiated for proposed or active flight plans by entering the subject aircraft identification including, if appropriate, qualifying conditions. The manually initiated probe analysis will accommodate the following probe analysis request conditions: (The parenthetically enclosed fields in the following are the optional qualifying conditions).

(a) PA ACID: This message serves either to acknowledge the displayed results from a previous analysis, or to initiate a probe analysis with respect to the identified subject aircraft in accordance with the stored flight plan. If the probed flight is a proposed flight plan, the probe analysis will generate an APREQ (approval request) response.

(b) PA (ALTITUDE) ACID: Probe at proposed altitude.

(c) PA (ROUTE) ACID: Probe at proposed route.

(d) PA (SPEED) ACID: Probe at proposed speed.

(e) PA (ALTITUDE) (ROUTE) (SPEED) ACID: Probe at combinations of proposed changes.

(f) PA (ACID) ACID: Probe subject flight against other identified flight. If the probe is against a second flight, at most only one accompanying flight data change can be proposed for the subject flight in one probe analysis message.

(g) PA (TIME) ACID: Schedule probe of subject flight at future time indicated.

(h) PA (PROPOSED-TIME-OF-DEPARTURE) ACID: Perform an APREQ probe using the entered proposed departure time in lieu of the flight plan's stored time.

(i) PA... (M) OR (C) ACID: Probe using the indicated longitudinal separation, i.e., "M", meaning Mach number technique, or "C", meaning conventional longitudinal separation.

6.2.1 SOURCES

This message originates from the DEC.

6.2.2 CONTENT

The message consists of:

01 Message Type (PA)

(02) Aircraft Identification (of "other" aircraft)

02 Aircraft Identification (of subject aircraft)

(05) Speed

(07) Coordination Time. ("speculative" proposed departure time for APREQ).

(09) Requested Altitude

(10) Route Data

(67) Time

(90) Longitudinal Separation Indicator. (newly defined field; "M" for Mach, "C" for conventional).

NOTE: THE FIELDS ENCLOSED IN PARENTHESIS ARE OPTIONAL.

6.2.3 INPUT CHECKING AND PROCESSING

The general checks specified in 3.3 shall apply. If optional fields are included, the following limitations apply. If optional Field 02 (other Aircraft Identification) is entered, only one of Fields 05, 09 or 10 may accompany it. Fields 05, 09 and 10 can be entered singly or in any combination. Field 07, or 67, or 90 can only be entered as the sole optional field.

6.2.4 PROCESSING AFTER ACCEPTANCE

A check shall be made to determine if it is an acknowledgment. If not, the flight path/profile, trial or existent, of the subject aircraft will be probed in accordance with the conditions of the request against other aircraft or reserved airspace at co-altitude. Paragraph 6.1.3 will apply.

6.2.5 RESULTANT OUTPUT

If the input is an acknowledgement, an appropriate internal message will be sent to Display Processing to discontinue the message(s) display. Otherwise, the output shall include:

a. Tabular response:

(1) A repeat of the probe analysis request message, plus if an altitude was not requested in that message, the currently assigned altitude.

(2) The conflict analysis.

b. Graphic response: (For a parameter period, nominal value, 30 seconds)

(1) A Route Display of each of the conflicting aircraft.

(2) Blinking of the ACIDs in the data blocks of the conflicting flights.

The output is addressed in detail in Paragraph 6.3.

EXAMPLES: PA 370 AA42. - Probe AA42 at proposed altitude FL370.

PA P1545 UA801. - APREQ Probe UA801 at speculated proposed departure time 1545.

PA IB300 TC377. - Probe TC377 (present speed, altitude and route) against flight IB300.

6.3 OUTPUTS

The probe analysis outputs shall be relevant to the subject aircraft and shall be output at the normal display refresh cycle. If there is no conflict, it shall be so noted in a tabular response. If there is a conflict, the responses, both tabular and graphic, shall identify the conflicting aircraft and situation i.e., subject aircraft and data, conflicting aircraft and data, (second) conflicting aircraft and data; etc.

3.1 TABULAR RESPONSES

The tabular messages that result from the execution of the probe analysis shall be listed under the discrete heading, “Probe Analysis”. The message content shall vary according to the conflict situation.

3.1.1 FOR THE SUBJECT FLIGHT

(a) Subject ACID.

(b) Assigned altitude and/or requested (proposed) altitude. If the request proposed a change in altitude, an altitude qualifier, i.e., " ", or " ".

(c) Other proposed change(s) in flight data or request conditions, if any.

(d) Depending on the situation one or more of the following code words and accompanying data:

(1) NOCONF (No conflict detected), and the current time.

(2) INTSXN (Intersecting route centerlines), point of route centerline intersection and ETA at that intersection.

(3) OVRTAK (Overtaking flight paths), and the point of losing longitudinal separation and ETA at that point.

(4) OVRLAP (Overlapping protected airspace). This code word and the detailed data will accompany the conflicting aircraft entry only.

(5) For transitioning flights, there will be a two level analysis:

(a) An analysis of the requested “final” altitude resulting in a response per one of the situations described in (1), (2), (3) or (4) above, and, on a new line,

(b) TRANSIT (an analysis of the transition, i.e., an analysis with respect to the usuable altitudes being traversed), and if applicable, the situation described in (1) above. If situations (2), (3) or (4) apply, the analysis data shall accompany the conflicting flight entry.

(6) APREQ (approval request), and:

(a) One of the situations described in (1), (2), (3), or (4) above, and if a potential conflict exists,

(b) Identify, per the adapted rules an alternate altitude that is conflict free, e.g., “310 NOCONF 1648”, or if none are conflict free, the word “NONE”.

6.3.1.2 FOR THE POTENTIALLY CONFLICTING FLIGHT(S)

(a) ACID (May be multiple entries).

(b) If the probe analysis concerns an altitude change, the altitude (In transition situation, may be multiple entries correlated with ACID).

(c) Depending on the situation, one of the following:

(1) (INTSXN) ETA at intersection points and times of airspace overlap when the potential conflict begins and ends.

(2) (OVRTAK) No entry or data... (Needed data already provided for subject flight).

(3) (OVRLAP) Times when the potential airspace overlap conflict begins and ends.

(4) (TRNSIT) In accordance with (1), (2), or (3) above, whichever is applicable.

6.3.1.3 EXAMPLES OF TABULAR DATA ARE AS FOLLOWS

(a) ALTITUDE REQUEST: (PA 350 IB300)

IB300, assigned FL 330, requests FL 350. Upon receipt of the manual request from the controller, the trial probe analysis response could appear as follows:

IB300 350 INTSXN 4340/5410 1545

BA474 350 1559 OVRLAP 432015432 1524 - 440115454 1634

The intersection of the flight paths is at 434015410. The estimates of IB300 and BA474 at the intersection are 1545 and 1559 respectively. The airspace overlap begins at 432015432 at 1524, and ends at 440115454 at 1634. (Air space available after 1634). No usable FL is traversed during the climb.

(b) NON INTERSECTING FLIGHT PATHS:

(Automatically triggered on flight plan activiation).

DL400 330

AV175 330 OVRLAP 2955/6014 2013 - 3059/6103 2107

DL 400's route centerline does not intersect that of any other flight but its protected airspace laterally overlaps that of AV175 as indicated.

(c) TRANSITIONING FLIGHT: (PA 370 PA1) Pan Am Flight 1 (at FL310) is requesting FL370.

PA1 ( ) 370 NOCONF 1440

TRNS IT

TW40 330 OVRLAP 4240/6938 1439 - 4321/6752 - 1521

TC416 350 OVRLAP 4420/5532 1550 - 4501/5555 - 1700

There is no potential conflict at FL370. However, in the climb from 310 to 370, two potential overlap conflicts are indicated. (Assuming current time is 1440, PA1 cannot begin climb until the airspace overlap with TW40 at 330 ends at 1521, but then should climb so as to reach 370 before 1550 when the airspace overlap begins with TC416 at 350).

6.3.2 GRAPHIC OUTPUT TO PVDS

When a potential conflict exists, the system shall blink the ACID in the data block of the subject aircraft and shall output the following data for display on the PVD of the sector controlling the subject aircraft. Both the route displays and the ACID blinking are subject to time-out.

(a) A Route Display on the subject aircraft;

(b) A Route Display on the conflicting aircraft when that route is within the area being displayed by the sector controlling the subject aircraft.

(c) If within the area being displayed by the sector controller the subject aircraft , the ACID of the data block of the conflicting aircraft shall be blinked.

6.3.3 OUTPUT TO THE LINE PRINTER

Each execution of a conflict probe, whether determining a potential conflict or not, shall be fully described in a message transmitted to the line printer. The message, as a minimum, shall include all information in the alphanumeric message sent to the PVD, the time of the probe, whether it was manually or automatically initiated, and the identity of the probe request source.

6.3.4 LOGGING

Information about each conflict probe executed, whether a potential conflict is determined or not, shall be recorded with other ODAPS data. The output of conflict probe information in the historical data recovery program shall be selectable in terms of time, aircraft or CID identification, sector, whether or not a conflict was found, or any combination thereof.

7.0 INTERFACES

In order to provide ODAPS with the necessary data base and to efficiently exchange flight plan data, on-line interfaces shall be required with NADIN and with various facilities, including en-route automation systems. All interfaces shall provide processing to insure positive disposition of all message transactions and an indication of disposition including printouts or unsuccessful transmissions. The contractor shall install and test all interfaces between ODAPS, NADIN, and the facilities listed. A detailed description of the functional interfaces required for ODAPS is contained in the Appendices. Interfaces include the following:

7.1 DOMESTIC ARTCC AUTOMATION SYSTEMS

The ODAPS shall interface with up to six (6) ARTCC automation systems for the exchange of flight plan data identical to that described in Section 2, NAS MD-315.

7.2 ARINC

ODAPS shall interface with the ARINC data net through the appropriate NADIN concentrator and shall accept messages in ARINC format. Data will be extracted from Progess Report (PR) messages and used for updating ODAPS data base. Details concerning use and validation of the PR are contained in Paragraph 4.2. Provisions for future interface with enhancements in the ARINC communications addressing and reporting systems (ACARS) shall be provided when sufficient data is available to define the interface and data formats.

7.3 AFTN

ODAPS shall interface with the Aeronautical Fixed Telecommunications Network (AFTN) through the appropriate NDIN concentrator. ICAO formatted flight plans shall be accepted and acknowledgment message sent. The AFTN is an integrated worldwide teletypewriter communications system of fixed circuits. The AFTN provides communications service for not only aircraft movements, but also administrative messages and meteorological data between FAA facilities and between FAA and ICAO nation facilities. The ODAPS shall interface with the AFTN, primarily for the exchange of flight plans, and flight data related messages.

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ODAPS shall interface with the ARINC data net through the appropriate NADIN concentrator and shall accept messages in ARINC format. Data will be extracted from Progess Report (PR) messages and used for updating ODAPS data base. Details concerning use and validation of the PR are contained in Paragraph 4.2. Provisions for future interface with enhancements in the ARINC communications addressing and reporting systems (ACARS) shall be provided when sufficient data is available to define the interface and data formats.

7.3 AFTN

ODAPS shall interface with the Aeronautical Fixed Telecommunications Network (AFTN) through the appropriate NDIN concentrator. ICAO formatted flight plans shall be accepted and acknowledgment message sent. The AFTN is an integrated worldwide teletypewriter communications system of fixed circuits. The AFTN provides communications service for not only aircraft movements, but also administrative messages and meteorological data between FAA facilities and between FAA and ICAO nation facilities. The ODAPS shall interface with the AFTN, primarily for the exchange of flight plans, and flight data related messages.

7.5 **WMSC**

ODAPS shall interface with WMSC. This interface shall be direct and discrete. AFTN includes the interface with the National Weather Service for winds aloft data. See Paragraph 7.3 above.

7.6 NON-U.S. ATC SYSTEMS

An interface shall be provided with non-U.S. Systems for on-line exchange of flight data and amendments to that data.

7.7 IFSS/FSS/FDIO

The ODAPS shall exchange flight data and related messages with terminal equipment at IFFSs/FSSs. If FDIO is available, then FDIO equipment shall be used for flight strip printing, data entry, and display at both remote facilities such as IFSS/FSS and at the oceanic sectors.

7.7.1 FDIO INTERFACE

ODAPS shall interface with the FDIO Central Control Units (CCUs) for the exchange of data with FDIO equipment (FSPs, CRTs, and keyboards) at sector positions. It shall be acceptable for the contractor to interface the ODAPS directly with the FDIO Remote Control Units (RCUs) instead of the CCUs for communication with the CRT, keyboards, and FSPs for adaptation for the remote facilities.

7.7.2 LOCAL CRT DISPLAY

The CRT displays shall be located at the sector positions. The ODAPS shall output the following data to discretely addressed CRTs for display:

(a) Flight data messages, updates and alerts thereto;

(b) Winds aloft messages and updates thereto;

(c) Response messages, such as accept, reject and error messages; and

(d) Probe messages.

7.7.3 (FDIO) REMOTE CRT DISPLAY

CRT displays shall be located at remote positions (IFSS/FSS). The ODAPS shall output the following data to discretely addressed FDIO CRTs for display:

(a) Flight data messages, updates and alerts thereto;

(b) Winds aloft messages and updates thereto;

(c) Response messages, such as accept, reject and error messages;

7.7.4 FDIO ALPHANUMERIC KEYBOARD INPUT

The ODAPS shall accept (for processing) flight data miscellaneous information, and information request messages input at qualified FDIO keyboards.

7.7.5 FLIGHT STRIP PRINTER

The flight strip printers shall be used to print flight progress and coordination strips, both locally and remotely, and other information as described herein.

7.8 OTHER EQUIPMENT

7.8.1 SUPERVISORY TERMINALS

Terminals shall be provided at ODAPS supervisory and other selected positions. The terminals shall have an optional printing capability. The term "IOT" (input/output typewriter) used in references designated herein shall be interpreted as the terminals described in this paragraph.

7.8.2 CARD READER

A card reader shall be used for input of messages to the ODAPS processor and off-line systems.

7.8.3 LINE PRINTER

Two line printers shall be provided for each ODAPS installation for off-line operations by supervisory personnel. One line printer shall be available as a backup to the other or for other off-line operations.

7.8.4 MAGNETIC TAPE UNITS

Magnetic tape units as described in this specification shall be provided.

7.8.5 DISK UNITS

Disk units as described in this specification shall be provided.

7.9 NADIN

ODAPS shall interface with NADIN for the exchange of data with AFTN, ARINC, and the Service B network. AFTN will provide for the exchange of administrative messages and messages concerning aircraft movements. ARINC will provide the means to receive aircraft progress reports, and Service B will provide for other required communications such as with IFSS/FSS and other Service B users.

7.10 INTERFACILITY MESSAGES

Where there is a two-way exchange of messages between ODAPS and another facility, any one of the following messages shall be used:

(a) DA - TRANSMISSION ACCEPTED - (SEE NAS MD 311, 7.5)

(b) DR - TRANSMISSION REJECTED - (SEE NAS MD 311, 7.6, and NAS MD 315, TABLE 2-2.)

(c) DT - DATA TEST (SEE NAS MD 311, 7.7)

(d) DX - RETRANSMIT (SEE NAS MD 311, 7.3)

(e) TD - TEST DEVICE (SEE NAS MD 311, 8.5)

(f) TR - TEST MESSAGE (SEE NAS MD 311, 8.6)

7.9 NADIN

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(f) TR - TEST MESSAGE (SEE NAS MD 311, 8.6)

8.0 SUPERVISORY, PLANNER AND MISCELLANEOUS MESSAGES

8.1 SUPERVISORY POSITION DESCRIPTION

The system shall support a unique position for on-line system management. This position shall be furnished an input/output device which will be eligible for input/output of normal flight data messages, plus an additional set of messages as follows:

8.1.1 SUPERVISORY MESSAGES

(a) PLANNED SHUTDOWN - Provides advanced printing of flight progress strips at time system is shut down.

(b) START PROCESSING - Starts automated mode. Either initial or restart from stored data base mode.

(c) RESECTOR - Establish or modify current sectorization.

(d) SECTOR ASSIGNMENT REQUEST - Printout Current Sectorization.

(e) INHIBIT TRANSMISSION - Enables, or discontinues individual interfacility data links to ARTCCs, ARINC, AFTN, WMSC, NADIN, Non-US ARTCCs, 9020 CCC, CARF, or FDIO.

(f) INHIBIT WAITING RESPONSE - Eliminate/resume requirement to receive responses from adjacent facility. NAS MD 311, 6.7.

(g) CORRECTION MESSAGES - To correct flight data messages from remote sources which fail format logic or legality checking.

(h) READ/MODIFY MEMORY* - Provides capability to modify system data on-line.

(i) CHANGE PARAMETER - To change parameter values on-line.

(j) ACTIVATE/INHIBIT SYSTEM RECORDING* - Selects predefined levels of recording.

(k) OTHER - Any supervisory activity determined 'by system design activity.

* THE FORMAT OF THIS MESSAGE REMAINS TO BE DEFINED

8.1.2 PLANNER MESSAGES

(a) ENTER/CANCEL ROUTE - To provide capability to enter a route for processing as if it were adapted route.

(b) DISPLAY FIR BOUNDARY TIME AND POSITION OF FLIGHT.

(c) DISPLAY ADIZ BOUNDARY TIME AND POSITION OF FLIGHT.

(d) DISPLAY TIME AT COMPULSORY REPORTING POINTS FOR FLIGHT.

(e) SYSTEM LOAD - Provides capability to extract the number of active flights and/or the number of inactive flights either by total or for a defined period.

NOTE: THE FORMAT OF PLANNER MESSAGES REMAIN TO BE DEFINED.

8.2 MISCELLANEOUS MESSAGES

8.2.1 ICAO MESSAGES

ODAPS shall provide the capability to generate, process, transmit and receive International Civil Aviation Organization (ICAO) messages (i.e., FLP - DEP). Procedures for handling these messages and the message formats are contained in ICAO Document 4444-RAC/501/10, Part VIII and Appendices 1, 2 and 3. Also, see 4.2.3 and 4.2.6.

8.2.2 GI (GENERAL INFORMATION)

This message is used to enter information desired for output at specified locations or positions. Further details on GI message processing are contained in NAS-MD-311, 8.3.

8.2.2.1 SOURCES

The message can originate from a keyboard, FDIO, 9020 CCC, or an IOT.

8.2.2.2 CONTENT

The message consists of Field 00 (Source Identification, 9020 CCC only), Field 01 (Message Type), Field 16 (Output Routing), and Field 11 (remarks). There may be multiple Output Routings entered.

8.2.2.3 INPUT CHECKING

The checks specified in 3.3 shall be performed. Field 16 (Output Routing) shall be checked to assure that it is one of the following:

(a) A letter (definable in adaptation) indicating the group of terminals to which the message shall be sent;

(b) A sector number;

(c) A letter indicating which IOT should receive the message;

(d) A remote location or position;

(e) An adjacent US or non-US center identifier;

(f) Other codes as necessary to send a GI message to adjacent US and non-US facilities. Certain codes shall be accepted only from adapted positions. The last field in a GI message shall be considered a Field 11 (Remarks) and must contain a clear weather symbol (0); otherwise, a rejection message shall be transmitted to the source. Refer to NAS-MD-311, 8.3.3 for details; and

(g) All positions at the facility, etc.

8.2.2.4 PROCESSING AND OUTPUTS

An accept or reject shall be transmitted to the source upon input of a GI message . The message shall be formulated and transmmitted as indicated. No response shall be expected from an addressed computer.

9. BEACON CODE ASSIGNMENT

9.1 GENERAL

The ODAPS is not supported by radar and therefore it would appear that there is no internal utility for a secondary radar beacon code assignment function. However, because some flights will penetrate an Air Defense Identification Zone (ADIZ) while in CDAPS airspace, and since it is beneficial to the Air Defense Command's mission for such aircraft to be responding on a discrete code' CDAPS will provide a beacon code assignment function.

9.2 ASSIGNMENT CODES

Code blocks shall be allocated to CDAPS facilities and shall be adapted for assigning discrete codes for qualifying flights. A code block is defined as "one, a portion of one or more, or more than one code subset."

9.3 ASSIGNMENT QUALIFICATION

A flight will qualify for discrete code assignment given that the following conditions are satisfied:

(a) The flight is discrete code capable.

(b) The flight will penetrate an ADIZ, and

(c) The flight, upon egressing ODAPS airspace, will be entering an airspace wherein discrete codes are utilized.

9.4 ASSIGNMENT TIMING

The assignment of a code to a flight plan will be made upon the occurrence of one of the following two events, whichever is the later:

(a) Activation of the flight plan, or

(b) A time interval (parameter) before crossing the ADIZ.

When a flight plan is dropped after exiting the ODAPS airspace, disassignment shall occur, i.e., its assigned code will be retured to the code pool for subsequent reassignment.

9.5 ASSIGNMENT LOGIC

There will be a code block adapted for each of the relevant adjacent airspaces, and code assignment shall be made accordingly, The same discrete code shall not be assigned simultaneously to more than one flight plan. Also' a rotation scheme will be utilized to maximize the time interval between successive assignments of a given code. When all the discrete codes in a code block are in use, the assigned code shall be a basic code from that block. If code assignment procedes strip printing, the assigned code shall be printed on the strips; otherwise, an update message shall be required. Only one code assignment event per flight plan will occur. The discrete code assignment shall be preserved through startover.

0.0 ADAPTATION

Adaptation is the storage of parameters and data to be accessed by a generalized computer program to enable that program to satisfy unique requirements. The operational program shall be identical for all sites. The parameters and data required to meet the unique needs of the individual sites shall be adapted. Parameters may be dynamic or nondynamic. A dynamic parameter shall be subject to change while the operational program is on-line while a nondynamic parameter is one that can be changed only in the off-line mode. Changes to adaptation data shall be made by entries in near plain text form and converted by the support programs to machine-useable form. Provisions shall be made for the operational program to switch from new adaptation data to old adaptation data in order to validate the new data. Documentation of adaptation procedures and formats shall be provided.

.0.1 FIX POSTING AREA (FPA) STRUCTURE

Fix posting areas are adapted by a series of three or more straight lines, whose end points are defined by nodes, with associated altitudes for each line to define a volume of airspace. They are identified by four digits, the first two of which are the same as the identity of the sector with which the FPA is adapted in the basic sector plan. An FPA may be defined with no airspace to satisfy unique operational requirements.

The following information is adapted for each FPA:

(a) Adjacent FPA's and/or centers for each wall

(b) An indication of more than one module per FPA or an excluded module

(c) The focal point fix (optional for oceanic FPA)

(d) A no-post indicator (optional)

(e) ATS and other adapted routes and S-lines within the FPA (optional)

(f) Oceanic indicator

(g) Entry point posting indicator (optional)

(h) Direct route posting priority (optional)

(i) Wind Station (required if no focal point fix associated with an oceanic FAP, otherwise not adapted)

10.2 SECTOR STRUCTURE

A sector is an air traffic control position, within an ARTCC, that is responsible for the control of air traffic within an area defined by geographical boundaries and, in some cases, altitude limits. It is identified by 2 digits and may also be identified by a sector name (2-5 alphanumerics). The sector airspace is composed of smaller volumes of airspace called Fix Posting Areas (FPAs).

FPAs may be reassigned to different sections and sectors may have all their airspace assigned to other sectors.

10.3 NODES

Nodes are geographic points and to define the horizontal structure of FPAs, S-lines, sector boundaries and center boundary. They are identified by latitude and longitude.

10.4 FIXES

A fix is any geographical point identified by a unique identifier of two to twelve alphanumerics. Fixes are located by latitude and longitude. Information adapted for each fix includes:

(a) Magnetic variation

(b) Upper wind reporting station

(c) Overlying structure (FPA's or adjacent centers) by altitude ranges

(d) Boundary crossing fix indicator

(e) Geographic Map

10.4.1 INTERCENTER COORDINATION FIX

The capability shall exist to adapt various types of fixes to be used for route description and in determining fix posting. Specifically, ODAPS shall have the capability to process and utilize the Intercenter Coordination Fix which shall be used as a common reference point between centers.

10.5 ADJUSTED ROUTES

10.5.1 ATS ROUTES

An ATS Route is identified by two to five alphanumerics. Information adapted includes:

(a) The fixes, in sequential order, that lie on the route

(b) Direct fix

(c) Posting priority codes or special indicators to determine fix postings generated

(d) FPA's and altitude ranges for each fix (optional)

(e) Coordination fixes (optional)

(f) Off route connected fixes (optional)

(g) Segment indicators for non-continuous adapted routes

(h) Junctions with other routes (optional)

(i) Flight plan past posted fix

(j) Map information

10.5.2 ADAPTED DIRECT ROUTES

Adapted direct routes provide rigidly controlled fix postings for often used flight paths between two consecutive filed fixes.

Adapted direct route adaptation contains:

(a) The two fixes to which the route applies

(b) The altitude range within which the adapted direct route applies

(c) The adpated route to be used for the segment.

10.6 S-LINES

One or more S-lines may be associated with an FPA to provide an additional fix posting on direct route flights which cross the S-line within an adapted heading range. An S-line is identified by the letters SL followed by three digits. The identity of the FPA to which the flight strip is forwarded is adapted. Map information which may be declared in S-line adaptation includes the Center Map Number(s) on which each line segment is to be displayed.

10.7 PARAMETERS

Parameters may be adapted at any value within an expected use range. Some parameters shall be adapted in the specific records which they apply. Others, used center-wide, will be adapted in the parameter list. Parameters shall be specified as Dynamic or Non-Dynamic and with a nominal value, range of values and the increment by which the nominal value may be changed.

10.8 MONITOR PARAMETERS

Monitor values which may be changed at the facility shall also be adapted. As specified above.

10.9 MESSAGE ADAPTION

The eligible message types shall be identified, including any special functions required to execute acceptance processing.

10.10 DEVICES

All local (within the center) and remote devices are adapted.

Remote devices include: adjacent center, FDIO, and teletype.

Adaptation provides for the routing of program generated messages (rejections, referred errors, etc.) to a specific device based on source and type of message.

10.11 GEOGRAPHIC MAPS

The capability to identify specific geographical data to be displayed on the PVDs as sector map data shall be provided. See 5.0 for display requirements. It shall be possible to identify up to four separate maps that cover the entire center area. The contents of each of these center area maps shall be site adaptable and contain different data. As a minimum the types of data listed below shall be eligable as map data and displayed on the PVD as indicated:

(a) FIXES - Single Symbols

(b) ROUTES - Lines between fixes (a gap between the fix and start of lines shall be site adaptable).

(c) AIRPORTS - Single Symbols

(d) BOUNDARIES - Center - form of dashed lines

Airspace - form of dashed lines

Sector - form of dashed lines

(e) ADAPTED DIRECTS - Same as ROUTES

(f) Land mass outlines.

(g) Alphanumerics (to indicate lat/log grid coordinates).

See NAS-MD-3161326 for further details.

The initial creation of the geographic map will be performed as an off-line function. The results of this assembly function (geographic map) shall be intergrated with the operation system for dynamic access and transfer to the display system.

10.12 UPPER WIND TABLE (WINDS ALOFT)

A winds aloft table shall contain the wind station identifiers and altitudes for which wind data will be stored. The altitudes for which the wind data may be entered are site adaptable. From 5,000 feet through 25,000 feet, the altitudes may be specified in 5,000 feet increments. Between 26,000 and 37,000 each altitude may be specified. From 39,000 through 45,000 the altitudes may be specified in 2,000 increments. Above 45,000 a single altitude may be specified to be used at all altitudes above 45,000 for ground speed calculation. It shall be possible to identify an wind station for each 10 degrees of latitude and/or longitude.

11. SYSTEM RECOVERY AND RECORDING

The capability shall be provided to periodically record all or selected portions of the data base that is dynamically generated during system operations. This routine shall be a planned activity that shall collect the selected data at regular intervals or event initiated. The recorded data shall be utilized in re-establishing that portion of the data base after system failure or start-over.

11.1 DEFINITION OF RECOVERY DATA

Recovery data is that portion of the total base, utilized by the operational computer program, which is required to reconstruct the program environment necessary for effective resumption of air traffic control data processing activities after a halt in system operation. This identification of recovery data is based on the determination of the specific kinds of information required to perform system recovery. Specific data tables which comprise recovery data are designated during the operational computer program organization and design activity.

11.2 RECORDING OF RECOVERY DATA

A recovery data recording subfunction shall be performed which includes the extraction of recovery data from main storage and the transfer of the selected data to the recovery data file during system operation. The recovery data recording subfunction is operated periodically to produce updated versions of the recovery data information. An indication of the completeness and accuracy of the recorded recovery data is provided with each set of data contained in the recovery data recording. The time and day of month of data transfer for each set of recovery data is also written on the recovery recording data file.

(a) The frequency of operation of recovery data for recording purposes shall be selectable (parameter).

(b) The elapsed time interval of the most aged data set (maximum interval from most recent recovery file) shall be a parameter item.

Following any re-establish startup, in order to preserve unused data sets for possible subsequent re-establish startup attempts, data sets older than the data set used will not be destroyed for twice the interval between recordings.

11.3 CONTENTS OF RECOVERY DATA RECORDING

During system operation, recovery data recording shall contain one or more sets of recovery data records, each of which contains the following information:

(a) Identification.

(b) Time (including hours, minutes and seconds) and day of month of recovery data transfer from main storage to the recovery data file.

(c) Indication of completeness of the recovery data transfer.

(d) Indication of the reliability of the recovery data transfer.

(e) Recovery data main storage records (flight plan information and control information).

11.4 FREQUENCY OF RECOVERY DATA RECORDING

The frequency of operation of recovery data recording shall be a parameter whose specific value will be determined as a result of the operational program organization and design activity. This determination is dependent upon the following:

(a) The frequency of recovery data updating in main storage by the operational computer program for each type of recovery data.

(b) The frequency of modification of recovery data by operational inputs to the system.

(c) The maximum age of each type of recovery data for which the data could be effectively utilized for system recovery.

11.5 RECOVERY DATA RECORDING DESIGN CONSTRAINTS

Constraints on the design of the recovery data recording subfunction shall be the following:

(a) Recovery data shall be available through two independent paths to make a system recovery from most element failures possible.

(b) The amount of handling and processing of recovery data during extraction and transfer to the recovery data file is kept to a minimum.

(c) The total amount of information classified as recovery data shall be kept to a minimum, consistent with the requirement for sufficiency for system recovery.

(d) The allocation of recovery data to main storage shall be optimized for utilization in system recovery and for ease and speed of transfer to and from the recording medium.

(e) The ODAPS shall provide two separate storage units, or failsafe capability, for the purose of recovery data recording.

(f) The frequency of opeation of recovery data recording shall be established from the range ten (10) to 180 (one-hundred eighty) seconds in increments of half seconds.

11.6 UTILIZATION OF RECOVERY DATA FOR STARTUP/STARTOVER

A startup/startover function shall utilize recovery data in re-establishing the dynamic data base. In order for recovery data to be utilized for resumption of system operation, this data must be available at all times. This general requirement for continuous availability imposes the following specific requirements for completeness, accuracy, and timeliness of the recovery data:

(a) Recovery data must be extracted from main storage and transferred to a "safe" storage medium which is highly reliable and is not adversely affected by computer malfunction or other environmental failures.

(b) Recovery data must be readily retrievable from the "safe" storage medium.

(c) Recovery data in "safe" storage must be periodically updated to provide for the dynamic changing of the original set of recovery data in main storage as the operational system progresses in time.

(d) Transfer of recovery data from main storage to disk storage and vise versa must be checked for correct data transmission by examining any I/O errors encountered. There is no requirement for write verify operations or any further error checks for logical content of recovery data.

(e) The amount and kinds of information stored as recovery data must be sufficient to satisfy operational requirements for completeness and timeliness of a system recovery.

11.6.1 UTILIZATION OF RECOVERY DATA FOR THE RE-ESTABLISHEMENT MODE

At a minimum, the following capabilities which utilize the recovery data shall be provided:

(a) Flight Plan Information:	Using the recorded flight plan information regenerate and update the flight plan storage tables.
(b) Flight Plan Pointer Tables:	Flight Plan Pointer Tables shall be provided, if applicable.
(c) Configuration Tables:	Configuration Tables shall be provided.
(d) Temporary Storage Areas:	Temporary Storage Areas as required.

11.6.2 RECONSTRUCTION OF DISPLAYS

The type of data which shall be reconstructed at the displays is specified as:

(a) All Data Blocks (DB) which at the time of occurrence of startover were "requested", "forced", or "pointed out" shall be reconstructed. The sectors to which the DBs shall be routed are:

(1) The controlling sector as well as any other sector involved by reason of an existent transfer mode or which is a former controlling sector still eligible for displaying the DB (i.e., has not been deleted and is within "parameter" seconds of a previous transfer of control).

(2) Each Data Block shall be displayed with the same offset and the same controller entered leader length, if any, and the B4 character which was applicable prior to startover.

(b) Geographical Map Data shall be displayed based on the logical map requested at each PVD. If display offset was enabled, recovery will include offset coordinates. If an altitude filter was enabled, then recovery will include consideration for upper and lower altitude readout filter limits. If temporary airspace reservations were made, then they shall be displayed.

12.0 HISTORICAL RECORDING AND DATA REDUCTION

The capability shall be provided to record, for historical purposes, selected portions of the flight plan records and data that are used in the ODAPS system. Additionally, this recorded data shall be made available for editing.

12.1 HISTORICAL DATA RECORDING

Sufficient data shall be recorded on disk packs so that no flight plan data is lost when a disk becomes full. It shall be possible to record data for at least thirty-six (36) consecutive hours (not necessarily on the same disk) without operator intervention. The operator shall be alerted when the recording data set reaches "N" percent (parameter) full. The capability shall be provided to transfer the historical data recorded to magnetic tape for ease of storage.

12.2 HISTORICAL DATA RECORDING EDITOR

An editor shall provide off-line printer output of the data written during historical data recording. The editor shall be capable of operating simultaneously with the ODAPS Operational Program.

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13.1 DEFINITIONS APPLICABLE TO RELIABILITY AND MAINTAINABILITY

The following definitions apply:

(a) AVAILABILITY - System availability is the probability, at any instant in time over the service life of the system, that the system is fully operational. Allowed preventive maintenance times shall not be counted as unavailable periods unless the time allowed for preventive maintenance is exceeded.

(b) FAILURES - The definitions of failure and failure types shall be as specified in 3.1.3 and 3.1.4 of MIL-STD-781.

(c) MEAN-TIME-BETWEEN-FAILURES (MTBF) - MTBF is the average length of time a unit or system is expected to operate without experiencing a functional failure, excluding those intervals of time the unit or system is shut down for scheduled maintenance (13.3), and excluding any failures discovered and corrected during scheduled maintenance.

(d) MEAN-TIME-TO-REPAIR (MTTR) - MTTR is the mean of the times required to restore an equipment to an operational state after failure; it is equal to the total unscheduled outage time divided by the number of unscheduled outages.

13.2 RELIABILITY REQUIREMENTS

The system reliability shall be such that the system availability as defined in 13.1 shall exceed 0.98. The design shall be such as to preclude dependent failures among units. The system MTBF, excluding the failures from which automatic recovery is possible, shall be a minimum of 2200 hours. This MTBF shall apply to the on-line system and not any GFE I/O equipment.

13.2.1 EQUIPMENT RELIABILITY

The contractor shall submit, in his design data, predicted MTBF/MTTR calculations for each unit of equipment. The reliability requirements for each unit shall be as shown in Table IV.

TABLE IV

RELIABILITY AND MAINTAINABILITY FIGURES

UNIT	MTBF (HOURS-MINIMUM)	MTTR (HOURS-MAXIMUM)
CPU	6,400	0.5
Memory Module	6,000	0.5
MTU	4,000	2.0
Printer	5,000	2.0
Disc Control Unit	3,500	0.5
Disc Drives	12,000	1.0

13.2.2 FAIL-SAFE RELIABILITY FEATURES

13.2.2.1 DUAL PATH

Dual paths are required for the flow of data. Data need not flow through more than one path simultaneously; however, in the event of failure in one path, data shall be rerouted through one or more different paths. A single thread segment in the dual data path shall not exist, i.e., there shall not be a switch, connection, cable, etc., through which the data must flow at all times and which cannot be quickly passed by the data flow. The reliability of this dual path shall be equal to or greater than 5×10^4 hours.

13.2.2.2 ON-LINE RECOVERY FROM INTERNAL FAILURE

The system shall be designed to minimize the time required to sense, react and recover from any failure which may occur within the on-line modules.

13.2.2.3 RECOVERY FROM FAILURE

If a system module suffers any nontransient functional degradation due to internal failure(s), that module shall be declared to have failed. Redundancy shall be provided to insure prompt operational recovery from the failure of any single module.

13.2.2.4 SERVICE RESTORATION RESPONSE TIMES

The system design for redundancy utilization shall restore the failed system function(s) to the operational system within 30 seconds follow-ing a system module failure. If a function suffers an outage of less than 30 seconds, that outage is considered to have produced a module failure, but not a functional (operational) failure. Thus, reconfigurable redundant modules providing alternate signal paths can be used to extend a function beyond that of the individual module (or signal path) performing it. Reconfiguration shall be accomplished by the ODAPS data processor program. The system shall be designed to automatically effect reconfiguration and isolation of the failed equipment, and to notify maintenanre personnel via the Data Processor console of the system status. However, the reconfiguration program shall accept and respond to reconfiguration orders from the data processors console typewriter.

13.3 MAINTAINABILITY REQUIREMENTS

The following requirements shall be met:

(a) Scheduled system maintenance shall be required no more frequently than once every 90 days.

(b) The scheduled system maintenance periods shall not exceed 6 hours. The system shall remain operational for a continuous minimum of 4 of those 6 hours. Scheduled maintenance of the system units shall be accomplished within the 6 hour period.

(c) System MTTR shall be no greater than 40 minutes. At the upper 90 percentile point, system MTTR shall be no greater than 1 hour.

(d) MTTR for bench repair shall be 2 hours. At the upper 90 percentile point, bench repair MTTR shall be no greater than 4 hours.

(e) For ease of maintenance, system design shall exploit the use of modular system components.

(f) The repair of failed modules shall be conducted off-line and without interference with the operational system. The switchover to redundant modules shall be accomplished through reconfiguration.

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13.5 MAINTAINABILITY PROGRAM

13.5.1 MAINTENANCE APPROACH

The preferred maintenance approach shall be to localize the failure through use of software and hardware maintenance features and to replace the failed module elements or pluggable unit or component from spares; the actual repair of the replaced item should be accomplished at the convenience of maintenance personnel in a maintenance area.

13.5.1.1 SOFTWARE AND HARDWARE FEATURES

The software shall consist of data processor diagnostic programs and those programs developed for system integration that are capable of being used as system diagnostics. Hardware shall, to the greatest extent possible, present a software interface that allows application of computer program diagnostic techniques. Hardware features shall include failure sensing and status registers, maintenance indicators, overheating warning devices and cutoffs, test points, printed circuit card/assembly keying or coding to prevent misplacement of these units, and printed circuit card/assembly protection such that any attempt to replace a printed circuit card/assembly with the wrong type shall not result in damage to any card or assembly.

13.5.2 MAINTAINABILITY PROGRAM PLAN

The contractor shall prepare a plan for a maintainability program conforming to the requirements of paragraph 5.1, MIL-STD-470. The plan shall also address the following topics:

(a) Number and skill levels of personnel required to maintain the ODAPS;

(b) Circuit card assembly problem analysis and field repair techniques;

(c) Special test equipment for bench repair items; and,

(d) Repair verification techniques.

13.5.3 MAINTAINABILITY PROGRAM TASKS

The tasks in the maintainability program shall include, but not be limited to:

(a) MAINTAINABILITY ANALYSIS - The contractor shall analyze the maintainability of the ODAPS and its supporting equipment in accordance with Paragraph 5.2 of MIL-STD-470.

(b) MAINTENANCE CONCEPT PLAN - The contractor shall prepare a detailed maintenance concept plan in accordance with Paragraph 5.3 of MIL-STD-470. The plan shall be periodically updated as the design proceeds and shall reflect the maintainability design criteria, trade-offs, and predictions.

(c) MAINTAINABILITY DESIGN CRITERIA - The contractor shall establish, apply, and update as necessary, maintainability design criteria in accordance with Paragraph 5.4 of MIL-STD-470.

(d) MAINTAINABILITY DESIGN TRADEOFFS - During the design and development of the ODAPS, the contractor shall include maintainability considerations in all design tradeoffs in accordance with Paragraph 5.5 of MIL-STD-470.

(e) MAINTAINABILITY PREDICTIONS - The contractor shall make maintainability predictions and establish the appropriate preventive maintenance requirements in accordance with Paragraph 5.6 of MIL-STD-470. Preliminary predictions of mean corrective and preventive maintenance times shall be provided; updates shall be provided during the design and development stages.

(f) DESIGN REVIEWS - The contractor shall discuss the ODAPS maintainability program at the ODAPS design reviews. These discussions shall include, at a minimum, information of the type required by Paragraph 5.9 of MIL-STD-470,

(g) MAINTAINABILITY DATA COLLECTION - The contractor shall establish a data collection procedure for validating maintainability predictions and evaluating maintainability demonstrations in accordance with the requirements of Paragraph 5.10 of MIL-STD-470, with the phrase "ODAPS preliminary design review"' being substituted for "'contract definition."

(h) MAINTAINABILITY STATUS - The contractor shall prepare and submit maintainability status reports in accordance with Paragraph 5.12 of MIL-STD-470.

13.6 OFF-LINE MAINTENANCE REQUIREMENTS

The system shall be designed to be isolated from interaction. Specifically, each individual equipment must be capable of being disconnected and power cycled on and off without causing failure to any system component. The smaller modules (e.g., keyboards and consoles) shall be connected into the system via quick disconnect plugs so that they may be removed and replaced with a minimum of down time. The removal or replacement of the keyboard module shall not require the power to be shut down in the console nor shall it disturb other on-line equipments. Each module shall contain all required maintenance indicators and controls. Sufficient indicators and controls shall be provided for each module to satisfy the maintainability requirements and to aid in meeting the requirements specified in 13.2.

13.6.1 MODULE ELEMENT REPLACEMENT

Redundancy wthin modules may be employed to meet the reliability requirements, e.g., dual power supplied. The hardware shall be replaced by redundant hardware, where provided, on-line and repaired off-line.

13.6.2 INDEPENDENCE OF SUBSYSTEMS

Design of the system shall be such that a component failure in any one subsystem shall not induce a failure in any other subsystem.

13.7 MAINTENANCE AND TEST EQUIPMENT

The design of ODAPS equipment shall emphasize the use of standard test equipment, tools, and fixtures and shall minimize the necessity for special test equipment.

13.7.1 STANDARD MAINTENANCE EQUIPMENT

Standard maintenance equipment is defined as the tools and test equipment which are a part of a manufacturer's standard product line and which are available off-the-shelf. As established in the contract schedule, the contractor shall provide a list of recommended standard maintenance equipment and related accessories necessary for the installation, maintenance, alignment, and performance testing of the ODAPS and its supporting equipment. The equipment recommended by the contractor should be available from more than one manufacturer, and solid-state insofar as is practical.

13.7.2 SPECIAL MAINTENANCE EQUIPMENT

The contractor shall provide all special maintenance equipment, including tools, fixtures, test equipment, and software to meet the MTTR specified in 13.1. Special maintenance equipment is defined as all tools, and test and support equipment which does not qualify as standard maintenance equipment. Off-the-shelf equipment that requires modification to perform the required function is considered to be special maintenance equipment. The equipment shall meet all applicable construction and performance requirements of this specification.

14. PERFORMANCE CRITERIA

14.1 ACCURACY

All distances shall be computed with an accuracy of 0.1% or 1/2 nm of correct distances, whichever is less.

14.2 RESPONSE TIMES

Response time is defined herein as the interval between the time a complete message is received at the ODAPS communications interface to the time the ODAPS transmits the first character of the reply. Utilizing initial parameters, under a load level of 75 percent of the system capacity (15.8), the ODAPS shall have as a maximum the response times defined below:

(a) For messages from all local and remote terminals with responses to the source: response times for all messages not resulting in full or partial route conversion shall have a mean of 0.5 seconds; no more than 10% of these response times shall exceed 1.0 seconds. The response times for messages resulting in full or partial route conversion shall have a mean of 1 second; no more than 10% of these response times shall exceed 2 seconds. No response time shall exceed 4 seconds.

(b) For messages from all sources other than (a) above: the response times for all messages shall have a mean of 2 seconds; no more than 10% of the responses shall exceed 4 seconds. No response time shall exceed 6 seconds.

(c) Output of oceanic position data and conflict probe (graphic and alphanumeric) data to situation displays at oceanic sectors shall have site adaptable design capability. System parameters for output of graphic and alphanumeric data pertaining to oceanic position data and conflict probe data is as follows:

(1) Oceanic position data shall be:

(a) Displayed as a data block (DB).

(b) The extrapolated positions shall be calculated and displayed at intervals of parameter "n" minutes. This shall be a site adaptable parameter. With a range of from one (1) to sixty (60) minutes in changeable increments of one (1) minute.

(c) Display output processing of DB information shall nominally be accomplished within two (2) seconds.

(2) Conflict probe data shall be:

(a) Displayed as conflict probe information following manual or automatic initiation of the probe. Automatic initiation of the probe shall occur following activation of a flight plan, amendment or change in an aircraft's altitude, amendment (+ or - a parameter of time> or change in an aircraft's fix time reporting, amendment of change in an aircraft's oceanic ATC route or amendment or change in an aircraft speed (MACH speed). Manual initiation of the probe shall also require display of probe information.

(b) Output to the display system of probe information shall be accomplished at intervals of from four (4) seconds up to intervals of twenty (20) seconds. This shall be a site adaptable parameter which may be varied in four (4) seconds increments.

(c) Display output processing of Conflict Probe information shall nominally be accomplished within two (2) seconds.

15.0 SOFTWARE REQUIREMENTS

The contractor shall provide all materials and services necessary for the design, preparation, test, and delivery of operational, support, test, and diagnostic software programs required to meet the requirements of this specification. All deliverable programs shall be provided on magnetic tape and punched cards compatible'with the ODAPS equipment. Source programs, object programs, linkages, and other files shall be included so that FAA personnel can conveniently maintain the software. Requirements of FAA-STD-011) shall be met.

15.1 DESIGN AND CODING REQUIREMENTS

The requirements of this paragraph shall apply to all computer programs (software) developed to satisfy the requirements of this specification, including those that are supplied as off-the-shelf commercially available software packages unless otherwise approved in writing by the FAA. This shall apply to all off-the-shelf firmware including, but not limited to, tape handlers, disk handlers, processor executives, etc. The system software must be modular in design. Module size must be based on the ability to adequately maintain, test, and debug the coding. A module failure must not interrupt processing flows not dependent upon that module. Both operational and support software should use the same high order language and the same coding conventions. Documentation must be consistent for all software. All computer programs shall be designed and coded so that they are easily readable, understandable, and changeable. All computer programs shall be developed according to the following schedule:

(a) A Computer Program Functional Specification (CPFS) shall be developed and submitted to the FAA for formal approval. The CPFS shall contain all functional requirements for a total software package including interface functions, type of equipment to be interfaced, timing requirements and design considerations. Upon approval, the CPFS will be the governing document for all functional requirements of the software at time of delivery and shall define the entire functional scope of the deliverable software package.

(b) Following formal approval of the CPFS, a Functional Test Procedure (FTP) shall be submitted for FAA approval. The procedure shall be explicit and comprehensive and shall test all functional requirements of the CPFS. In addition, the test will demonstrate that the software does not perform undesirable functions and the system will operate error free at one-hundred (100) percent capacity. Included in the test shall be at least two weeks of extensive user operation of the software on site at the applicable FAA facility.

(c) Following approval of the CPFS the contractor shall submit a Computer Program Design Specification (CPDS) for each module of the program. The CPDS shall be written in computer program format (comments, instructions, indentation of loops, etc.) and shall look like an english language source program. The design, however, shall use only four types of commands:

(1) A plain english statement to perform a single step, i.e., multiply velocity by time and store into distance. This type of command shall not be used to perform elaborate procedures requiring subroutines. It may be used to perform procedures requiring simple library functions or macros, i.e., read a record from the flight data file tape.

(2) A command to invoke a single subroutine for a single, clearly explained purpose. This command shall always contain the same keywords and will explain the expected output from the sub-routine, i.e., CALL file scan (subroutine name) TO find the active flight plan file where CALL and TO are key words.

(3) A command allowing program decision making and clearly defining all paths to be taken as a result of the decision, i.e., IF (decision criteria); THEN (true decision path); ELSE (false decision plan), where IF, THEN, ELSE are key words. Additionally, contractor shall establish a single set of key words for use in all design documents.

(4) A single command allowing initiation of a clearly defined program loop and identifying criteria for exiting the loop, i.e., DO WHILE (event taking place); DO FOR ("n" number of cycles); REPEAT "n" TIMES; REPEAT UNTIL; etc. A loop shall always contain one entry point (first instruction) and one exit point (last instruction).

(d) Following approval of the CPDS for a given program module, the contractor will submit a Module Test Procedure (MTP). The procedure will demonstrate that each step of the approved CPDS is fulfilled and that no adverse action is performed by the module. The module will be tested at zero (0) to one-hundred (100) percent design capacity. Critical timing considerations, if any, will be clearly demonstrated. All formal acceptance testing of a program module will be performed using FAA approved module test procedures.

Changes to any of the four FAA approved documents(i.e., CPFS, FTP, CPDS, MTP) will require re-release of all subordinate documents. For this reason a system of document control shall be formally implemented whereby all subordinate documents will contain explicit reference to applicable higher level documents (one level) and all test acceptance forms can be readily identified with the applicable FAA approved functional or design specification.

15.1.1 MODULARITY

15.1.1.1 MODULE COUPLING

Simple, easy to build, easy to maintain software system modules which are highly independent of each other and have simple, limited interrelationships shall be provided. Complexity shall be minimized by designing systems with the weakest possible coupling between modules. The smallest number of interconnections is required as well as connections which do not strongly couple any one module to another. Coupling strength shall be kept to a minimum using the following concepts:

(a) Global data shall be the only kind of shared data that shall be acceptable.

(b) The only type of connection that shall be acceptable shall be reference to a module as a whole by its name. For the purpose of this specification, a connection is a reference to some label or address defined elsewhere.

(c) The types of communication between modules shall be restricted to the passing of data, the passing of switches or flags, subroutine calls, and the passing of a table.

15.1.1.2 PREDICTABLE MODULES

A predictable module is one that, when given the identical inputs, operates identically each time it is called. Modules shall not be allowed to modify any code, either their own or that of another module. All modules shall be predictable.

15.1.2 DEVELOPMENT TESTING

As each release is developed and tested, FAA management shall be given evidence of progress through the demonstraton of a specific software system functional capability. A software release is defined as a set of computer programs that satisfy an easily identified set of requirements and shall be identified in the Design Data. Integration of a series of releases results in the completed software system (package). Demonstration of these releases to Government representatives shall be used to help improve confidence in the progress being made throughout development rather than just at completion.

5.1.3 CODING REQUIREMENTS

5.1.3.1 MODULE ORGANIZATION

A desirable characteristic of a program is that it be easily understood for testing, maintenance, and modification. It has been found that a principal approach to implementing this characteristic is to have the natural reading of code text match the control flow of the module (i.e., top to bottom). This usually involves utilizing several specific control logic structures and eliminating use of the unconditional branch statement **(GOTO)**

(a) FORMAT INDENTATION - A method of making code readable is to indent lines of code contained within a control structure to their corresponding logical depth. This enables the reader to immediately localize code affected by the control structure using visual inspection alone, as opposed to the possibility of investigating the logic of several nested structures in order to isolate the boundaries of each. Code indentation shall be required.

(b) LANGUAGES TO BE USED - The contractor shall code the operational program and any additional operational support subprograms in such a mannner as to enable the computer programming subsystem to operate in *an* efficient manner with primary concern given to software and firmware maintainability which may be readily changed and understood. The large majority of the coded instructions and data used shall be coded in a high order programming language specified in FIPS PUB 21-1 and approved by the Government. When, in order to meet the requirements of this specification, selected subprograms and data tables must be coded in assembly language, it shall be the contractor's responsibility to assess the relative cost/benefit factors involved. The contractor shall be responsible for identifying those subprograms selected, along with appropriate justifications, to the FAA for review and approval.

15.1.3.2 CODING PRINCIPLES

The Eollowing principles shall be employed in writing code:

(a) SOFTWARE STRUCTURE - The software system shall be structured into small, manageable, and independent modules. For this requirement a module is defined as a set of contiguous program statements having a name by which other parts of the system can invoke it, and preferably having its own distinct set of variable names. The module shall have one entrance, one exit, and be between five and two hundred executable source statements in length. The implementation of all required software shall be in modules. The computer program systems shall be developed in independent computer program modules which shall be written clearly and concisely using the practices of structured programming. This entails designing the control architecture first, along with interface requirements and data requirements. Subsequently, lower level functions are designed, and the process continued until all required functions and subfunctions, interfaces, and data requirements have been designed.

(b) GLOBAL DATA AND WORK AREAS - Standards for global work areas and data shall be defined and enforced.

(c) FLOWCHARTING STANDARDS - The design document shall be sufficiently clear to preclude the need for flow charts. If flow charts are used, they shall enchance clarity, understanding, use descriptive symbols and reference the program listing by use of statement labels or tags. All symbols used in flowcharts shall be in accordance with FAA Order 1370.148. Graphic symbols for logic diagrams shall be used in accordance with FAA-STD-010.

(d) STANDARD MACROS - Standard macros for linkages, register set definition, module initialization, and frequently repeated coding structures shall be identified.

(e) STANDARD MACRO AND UTILITY LIBRARY - Macros and internal subroutines which perform frequently required functions shall be maintained in a library.

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This section gives specific conventions for comments, naming (tags, labels), register usage, linkage conventions and identifies some practices to be avoided.

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15.1.3.3.2 <u>NAMING AND TAGGING CONVENTIONS</u>

Conventions for names (e.g., modules, local variables, data base) shall be provided to aid in the process of identifying the location and use of a particular section of code or data.

(a) <u>MODULE ENTRY AND EXIT POINTS</u> - These points shall have standardized labels.

(b) <u>LINKAGE CONVENTIONS</u> - Standard calling and returning sequences shall be used. For assembly language, standard register save areas shall be used.

(c) <u>MODULE ORGANIZATION</u> - A standard format for a module shall be selected.

15.1.3.3.3 <u>PRACTICES TO BE AVOIDED</u>

Several coding practices have been found to adversely affect the development and maintenance of software. The following practices shall not be used:

(a) Code modification, absolute referencing of memory, imbedded constants may be very useful.

(b) Mystifying constructions (e.g., the use in operative statements of literals whose meaning is not immediately clear from the surrounding code).

(c) The NOT Operator unless it adds to clarity; e.g., NOT (AA EQ BB AND CC EQ DD) is equivalent to **AA** NE BB or CC NE DD.

(d) Literals in operative statements. Declare all constants, comment them, and use the symbolic name. An exception may be made for integer 0, 1, and 2 if the meaning is clear from context.

(e) The same argument as both input and output to a procedure.

(f) Resetting the index of a loop in the body of the loop, and branching into a loop from the outside.

15.1.4 PROGRAM STRUCTURE

Each major function within a subprogram shall be written as a separate program task and shall be capable of being assembled independently. Program tasks shall be written to assure program modularity. It shall be possible to replace or add task functions independently with a minimum of changes to existing programs. Subfunctions within tasks that are common to more than one subprogram or task shall be stored in a single area of memory. With the exception of literals, which may be used when appropriate, the program shall be written in symbolic notation only. Absolute coding is not permitted.

15.1.4.1 COMPUTER PROGRAM DATA ORGANIZATION

The computer program data shall be organized in tables; each table shall be divided into elements or entries and each element shall be divided into items. An item shall be the minimal significant element of data.

15.1.4.2 CONSOLE TYPEWRITER SUBPROGRAMS

Subprograms or subroutines shall be added to the operational program to enable program loading, program modification, and input/output communication. In addition, utility and maintenance software shall contain appropriate program loading and input/output communication routines.

15.1.4.3 INPUT PROCESSING SUBPROGRAM

The Input Processing Subprogram shall process all inputs and shall provide checking and validation, code conversion, and internal formatting of each message.

15.2 SOFTWARE

The software shall consist of operational software and systems support software programs. The operational software shall consist of an executive program, subprograms, data bases, tasks, and the recovery program. The collection of tasks, properly interfaced with the executive program and linked to the data bases, shall form the operational program. A task shall be the basic operational programs module. Most tasks shall be written so that they may be loaded anywhere in main (computer) memory, shall be capable of being executed by any processor, and shall be capable of assembly independent of other tasks and the executive program. Subdivision of the ODAPS computer system (processors and memories) shall be possible by means of the computer partitioning hardware and the executive program. Normally, the computer system shall be divided into two computer systems, the operational and the support system. These systems shall be capable of concurrent and independent operation. The operational system shall always be under executive control. The support system shall not be permitted access to the operational system. The operational system shall be permitted access to the support system. Access from the operational to the support system shall be constrained only by manual override (manual partitioning via switches, or manual shutdown of a processor or memory).

15.2.1 OPERATIONAL SOFTWARE

The following is a list of the varous subprogram modules which shall be required as a minimum for the ODAPS:

(a) Executive control

(c) System timeout processing

(c) Recovery data recording

(d) Interfacility communications

(e) Historical data recording

(f) Console data terminal input processing

(g) Console data terminal output processing

15.2.2 SUPPORT SOFTWARE

The support software provided shall include, as a minimum, the following programs: Assembler, Builder and Builder Utility. These programs shall operate with the following peripherals, as a minimum:

(a) Disk subsystem

(b) Printer

(c) Card reader

(d) Data terminals

(e) Magnetic tape unit

(f) Interfacility link/display handler

15.2.2.1 RECOVERY SYSTEM LIBRARY

An organized set of programs, stored on disk and accessed by the executive shall perform the functions of a Recovery System Library (RSL). The RSL shall contain, as a minimum the following programs, and/or data by module:

(a) Recovery module

(b) Directory of the RSL

(c) Operational program

(d) A set of self-contained diagnostic programs for the following:

(1) Central processing unit(s)

(2) Memory modules

(3) Displays

(4) Printer

(5) Magnetic tape units

(6) Disk system

(7) Interfacility interface

(8) Input/output terminals

(e) A set of utility programs as follows:

(1) Assembler

(2) Builder

(3) Builder utility

(4) Data terminal utility

(5) Historical/continuous data recording

(6) Continuous data editor/reduction program

15.2.3 EXECUTIVE CONTROL

Executive control shall provide for the overall control of data processing, failure detection and recovery logic, and execution of the operational program tasks. The executive shall consist of identifiable areas of contiguous memory. It shall perform the following functions:

(a) Initializing;

(b) Scheduling;

(c) Interrupt control;

(d) Executive services;

(e) Recovery; and

(f) Debug.

15.2.3.1 INITIALIZING FUNCTION MODULE

The initializing function shall provide the control mechanism for the initialization of all hardware and software for either an initial start or a recovery restart of the operational programs. This function shall inspect and configure all system resources into an operable hardware configuration, identify the components and data paths in the system, initialize various tables and addresses and make all necessary preparation for normal execution of the operational program.

15.2.3.2 SCHEDULING FUNCTION MODULE

The scheduling function module shall dispatch program control to the subprogram tasks within the operational program. Scheduling shall be provided on a priority basis with provisions for task posting based on interrupts, realtime clock values, and messaes. Task priorities shall be selectable at system generating time.

15.2.3.3 INTERRUPT CONTROL FUNCTION

The interrupt control function shall provide the capability to process all interrupts other than task controlled channel interrupts and the return-to-executive interrupt.

15.2.3.4 EXECUTIVE SERVICES FUNCTION

The executive services function shall provide for data terminal input/output message control and processing routines for task initiated requests.

15.2.3.5 RECOVERY PROGRAM

A recovery sequence shall be provided that will detect, analize, report, and attempt recovery for all software and hardware faults. It shall be available from a primary and alternate storage device.

15.2.3.5.1 RECOVERY MODULE

The recovery module shall consist of software routines that conduct detailed checks on all data processing equipment modules. It shall determine which equipment module(s) are operable and then call in the highest level selected backup operational program that can operate in those modules. Startup of the backup operational program shall be automatic. The recovery module shall respond to the selection and load the proper backup operational program. The recovery module shall include recording of critical data required for system recovery.

15.2.3.6 DEBUG

This module shall be used in the support system only. It shall provide the tools necessary for efficient integration and checkout of operational programs.

15.2.4 STARTUP

The recovery and reconfiguration sequence shall be automatically entered for all operational program startups. Startup shall be initiated by single button start. The start-up task shall perform tests on all sub-systems and shall provide a method of notifying all positions when the system is available for use. All records shall be initialized and the initial time requirements of the system shall be established by this task.

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15.2.5.3.1 AUTOMATIC DISK RECONFIGURATION

When a disk drive failure has been detected, the operation shall be completed (when possible) by using another disk drive. If a disk overload is sensed, an automatic switchover to another disk shall occur.

15.2.5.3.2 MANUAL DISK RECONFIGURATION

A capability to manually energize each individual I/O channel or all I/O channels together shall be provided on the disk controller. Input messages shall be provided to select which channel shall be utilized by the system.

15.2.5.4 FAILURE DATA

All failure data shall be output on a printer. Failure data shall include but not be limited to:

(a) A processor storage resources map;

(b) The identity of the selected operational program;

(c) All data presently required on the NAS Documentation Form 7500-65 shall be printed out except data not accessible by the operational program;

(d) Recovery module failure data; and

(e) Time of failure.

15.2.6 ON-LINE CERTIFICATION

The on-line certification program shall consist of a collection of computer program modules/segments that provide information for certifying the operational capability of the ODAPS system. In general, the program shall consist of functional tests to be performed on the following subsystems as a minimum:

(a) Data processing subsystem (DPS);

(b) Interfacility/Interface subsystems (IFS);

(c) Historical data recording subsystem; and

(d) Peripheral equipment, to include printer, printer control unit, card reader and controller, magnetic tape unit and controller, disk units and controller, and input/output terminals.

The programs are categorized into three broad software functional areas as given below:

(a) Performance monitor segments that are core resident and continuously execute within the operational program software (OPS).

(b) On-call program segments that execute on operator request and are not main memory resident.

(c) The executive program which manages the processing of input requests and the scheduling of program segments, and is also main memory resident. The various executive program segments shall run asynchronously wth respect to the OPS program modules that permits them to be independently scheduled as required in the OPS scheduler.

15.2.6.1 INITIAL CONFIDENCE TEST

The initial confidence test (ICT) shall be an on-call task that serves three major functions. The ICT shall be responsible for verifying that the central processor instruction set is operational; that available memory is accessible; and that the various hardware interfaces to the processor are operational. Each of these tasks is independent of the other, but they shall be called in series from the main ICT program.

15.2.6.2 CENTRAL PROCESSING UNIT (CPU) CONFIDENCE TEST

15.2.6.2.1 FUNCTION

This portion of the ICT shall evaluate the processor instruction repertoire and monitor the real time clock.

15.2.6.2.2 LOGIC

The initial portion of the on-line certification initial confidence test shall test the basic instruction set. This shall entail performing individual instructions and comparing the result of this action to a predetermined result. If the actual result differs from the predetermined result, an error message shall be printed on an IOT or displayed, or both. A monitor shall then be performed on the real time clock. If the clock is not changing, an error message shall be printed on an IOT or displayed, or both.

15.2.6.3 MEMORY CONFIDENCE TEST

15.2.6.3.1 FUNCTION

The memory confidence test shall perform an addressing test and a data test on areas of memory available to the processor that can be tested without endangering the operating system.

15.2.6.3.2 LOGIC

This program shall store bit patterns in available sections of the operational memory modules. The bit pattern shall be read from memory and compared to determine whether the results are the same as the results that were stored. If an error is found, a message shall be printed on an IOT or displayed, or both and the program shall continue to the next memory module. If no error is found, the next bit pattern shall be checked until all such patterns are verified. The program shall then proceed to check the next memory module until all memory modules are tested. The second portion of the program shall perform an addressing test. The same available area of memory shall be used for this test. An address shall be stored into itself (i.e., address 040000 would contain the value 040000). The next portion of the test shall read the stored data and verify that they are unchanged. If an error is found, it shall be printed on the MSP. If an error is found, no further testing shall be performed on that memory module, but the program shall proceed to the next module until all memory modules are verified.

15.2.6.4 INTERFACE VERIFICATION TEST

15.2.6.4.1 FUNCTION

The interface verification test shall perform basic checks of the handshaking capabilities of the following interfaces:

(a) ODAPS - 9020 cccs;

(b) ODAPS - ARINC interface;

(c) ODAPS - Peripherals, i.e., printer, card reader, magnetic tape units, and IOTs;

(d) ODAPS - FDIO equipment;

(e) ODAPS - Non-U.S. ARTCC interfaces (e.g., GANDER);

(f) ODAPS - Appropriate NORAD facilities

(g) ODAPS - Service A/Service B/WMSC terminals;

(h) ODAPS - Disk units, including data recording function; and

15.2.6.4.2 LOGIC

In most cases the operational program is already using the peripheral devices to be verified. When this is the case, there will be an attempt to assign an alternate peripheral channel to the operational program. However, the test shall verify that alternate channel is functioning first. If there is no alternate assigned or if it is not functioning, a message shall be printed which implies no further testing will be performed on this peripheral. At this point, the interface between the primary peripheral and the processor shall be tested. If there is an error the error shall be printed and the operational program shall continue with the alternate channel and device. However, if no interface problem is detected, the test shall return control t the primary peripheral and channel. All peripherals shall be tested in this manner.

15.2.6.5 HISTORICAL DATA RECORDING READ/WRITE TEST

15.2.6.5.1 FUNCTION

The Historical Data Recording read/write test shall perform two functions. The first function shall verify the capability of the disk units to correctly read from, or write to the disks, by writing test words to the disk and then reading the same test words from the disk. The second function shall verify that the disk units do not have defective tracks.

15.2.6.5.2 LOGIC

This program shall first check whether Historical Data Recording is enabled. If not, the test shall not continue and an error message shall be printed. Next, two common subprograms shall be called. The first is the data recordin buffer index control. The input is the number of words to extract. The test shall indicate that it has an entire buffer to extract and will wait until a buffer is available. When it is available, the test messages will be stored in the buffer and the appropriate housekeeping performed. The data recording buffer output control shall be called next. On return from data recording buffer output control shall be imperative to save the cylinder, head, and record numbers. This information shall be used to read the information back from the disk. The data read from the disk shall be compared to the expected results. If an error is found, an error counter shall be incremented. An attempts counter shall be incremented regardless of the outcome. A separate counter shall be kept for each execution of the data recording read/write test. An error ratio shall be calculated to determine whether detected error exceed a parameter value. If so, an error message shall be printed. This routine shall be executed a parameter number of times each second. The parameters values shall be specified by the Government.

.2.6.5.2 PRINTER/DISPLAY/KEYBOARD/FDIO TESTS

These tests shall demonstrate that the printers/displays/keyboards/FDIO and processors operate together properly in all modes of operation. Specifically, the following functional capabilities shall be demonstrated:

(a) Perform input and output data transfers between the above mentioned equipment and the processors.

(b) The ability of this equipment to properly interpret and respond to external function roles sent from the processors.

(c) The ability of this equipment to develop and transmit external interrupts and associated interrupt data to the processors.

(d) The ability to accept digital data representing the character repertoire and to properly decode and display that data on the above mentioned equipments.

(e) The ability to accept, interpret, and execute the nondisplayable command codes.

15.2.6.7 ON-LINE OPERATION

On-line operation shall have the following characteristics:

(a) Individual tests comprising on-line certification shall be selected at the display console or the console typewriter.

(b) Test results and/or error indications shall be presented to the test operator or the console typewriter printer on the display console.

(c) It shall be possible to run selected tests separately or in combination.

15.2.7 SUBPROGRAM TASKS DATA BASE

15.2.7.1 TASKS

A task is a program segment that performs all or part of a function and consists of one or more addressing sections, each of which contains instructions or data (or both) which occupy consecutive memory addresses. Selected groups of tasks, properly scheduled, combine to perform a sub-program function. Tasks shall be written processor independent, memory independent, and assembly independent. Processor independence shall mean that the task may be executed by any processor. Memory independence shall mean that the task may be loaded into any memory module, and anywhere within a memory module. Assembly independence shall mean a task can be assembled without concurrent assembly of other tasks or executive modules. The executive builder shall load and link tasks, executive modules, and data bases. External address linkages shall be made at build time. Tasks shall be written in symbolic notation only. Input and output functions shall be initiated by the executive function upon execution of the proper instruction.

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15.2.9.4 EVENT SYNCHRONIZATION

The operating system shall prevent scheduling conflicts that could damage a task or degrade system efficiency, (e.g., A task shall not be scheduled for a CPU unless it has all of the other resources it requires. Two tasks shall not be assigned exclusive control of the same resource).

15.2.10 ALLOCATION TECHNIQUES

The operating system shall support static and dynamic resource allocation techniques. Dynamic allocation permits the operating system to allocate specified resources according to the current scheduling algorithm. Static allocation permits the fixed allocation of resources (e.g., queues, tape drives for statistical recording) during system generation, start-up, or during system operation. When operating system storage allocation techniques produce fragmentation, the operating system shall reorganize the internal storage assignments as needed so that storage requests can be fulfilled. Storage fragmentation may also occur in auxiliary storage. The operating system shall provide mechanisms that permit the analysis of space allocation on auxiliary storage, and effective use of storage that shall meet operational requirements and cannot be depleted. Upon the normal or abnormal termination of a task, the operating system shall ensure that all allocated resources are deallocated. Proper notifications shall be issued and specified resource utilization statistics shall be recorded.

15.2.11 STORAGE PROTECTION

The operating system shall provide storage protection for all the software components and programs within the system. System architecture and/or executive shall limit access to disk files and prohibit any program from violating or utilizing resources not allocated to it.

15.2.12 INPUT/OUTPUT CONTROL AND SUPPORT

The operating system shall support, control, and supervise all input/output operations.

15.2.12.1 DATA TRANSFER

The operating system shall support the efficient transfer of data between storage and peripheral devices. Its techniques shall prevent the slower speed of data transfer interfering with capabilities of the system's internal processing functions. Validity checks shall be made on all data transfers. If errors are detected, the operating system shall record the event and have the data retransmitted. The capabilities of disk-to-disk, disk-to-tape, and tape-to-disk transfer shall be provided.

15.2.12.2 DEVICE MANIPULATION

Device manipulation, without data transfer, shall be supported. Various types of device positioning shall be supported such as forward spacing and rewinding of tapes , positioning of read heads of direct access devices.

15.2.12.3 LOGICAL ADDRESSING

Application programs shall be able to reference devices only by logical device identifiers. The operating system shall decide which physical device actually services a particular request. It shall always maintain a correspondence between logical identifiers and the physical device identification. This correspondence may be altered whenever a physical device is added or deleted. Logical addressing shall give the operating system the flexibility to switch to an alternate device as appropriate.

15.2.13 INTERMODULAR DATA TRANSFER

The operating system shall provide facilities for the exchange of information between tasks, programs, and/or sections of a task.

15.2.14 MONITORING

The operating system shall continually monitor the status (e.g., wait state, executing, completed, illegal/legal action) of every hardware element, software component and application program.

15.2.14.1 SYSTEM STATUS REPORTING

The operating system shall inform an adapted position whenever it is unable to process specified tasks within response time requirements. Information provided to the operator will include as a minimum:

(a) Statement of the problem

(b) Hardware configuration

(c) Scheduling algorithms

(d) Priority structure

(e) Individual task status

15.2.14.2 ILLEGAL ACTION

If an illegal request is issued or a specified user or system limit is exceeded (e.g., program requested CPU time, time limit for I/O event), the operating system shall issue proper notification and initiate appropriate action (e.g., task termination, request operator intervention/decision). The method selected to handle the infraction will depend on the type of violation, e.g., system status, task type, etc.

15.2.14.3 EQUIPMENT STATUS REPORTING

Changes to the status of each major equipment, such as processors, memories, and disk units shall be automatically displayed and printed. The display shall remain until cleared by the operator and/or printed. Current equipment status shall be displayed and printed at an adapted position(s) on request.

15.2.15 ERROR PROCESSING

The operating system shall continually monitor all system activity. It shall in addition, detect, analyze, and report for software, and initiate recovery for processor failures. It shall selectively record and provide specified information that will assist system personnel to analyze errors, determine the cause, and develop preventive procedures.

15.2.15.1 ERROR DETECTION

The operating system shall include the capability to detect errors as they occur. It shall detect illegal action that affects software components, the data base, or application programs within the system. It shall identify hardware element errors or element interface errors.

15.2.15.2 ERROR ANALYSIS

The operating system shall analyze the type, cause and effects of detected system errors. The operating system shall print and record data concerning the error environment, cause, extent and other pertinent information. It shall generate dumps for specified errors.

15.2.15.3 SOFTWARE RECOVERY

If a software component or data base is impaired, (e.g., illegal instruction execution has occurred) the operating system shall initiate immediate restorative procedures and inhibit any use of the impaired component until repair is completed.

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15.4 SUPPORT PROGRAMS

Support programs, shall consist of those computer programs and systems which provide for the development, maintenance, generation, utilization, modification, and analysis of the various computer programs and computer program systems for the ODAPS. These programs should include, but not limited to, assemblers, compilers, utility programs, adaptation data assemblers, data edit and reduction programs and input simulator programs. Tools for updating and maintaining these support programs are required. Capabilities provided shall include support to the operational software, the support software itself, maintenance software and the operating system. These programs shall form an integrated system such that data may be easily passed from one program to another and so that one utility can accept the output of another. The required capabilities have been grouped into sections that specify logically related functions. This grouping is not intended to restrict the system design in any way or to dictate the modularity of the compo-nents. These sections are service utilities, software production and testing utilities, system generation and adaptation, and system reporting functions. In addition all support software used for the development, testing and maintenance of a delivered computer programs (including operational software, support software, maintenance software and the operating system) shall be provided.

15.4.1 SERVICE UTILITIES

The service utilities shall provide, under control of the operating system, a full range of file support operations for all system media.

15.4.1.1 GENERAL FILE MAINTENANCE/EDITOR UTILITY(IES)

The system shall provide general purpose file management capabilities for the production, text-editing and maintenance (e.g., addition, deletion, move/copy, replace, merge, relabel) of data files, program source code files and program object code files. The system shall be capable of performing physical and/or logical comparison of at least two input files from the same or mixed media (e.g., tape/disk). It shall be able to output specified files on specified devices (e.g., print/punch). Various user options shall be provided. These include character conversion, block/record selection, header data, print line and punch formatting.

15.4.1.2 AUXILIARY STORAGE FILE UTILITY(IES)

The system shall allow the system user to utilize system data management functions to reserve, delete, reorganize, and characterize space on the devices. It shall permit the reproduction of disk based files (in various file organizations) onto disk, tape or printer. It shall provide for the printing of disk file characteristics data (e.g., space reservation, disk condition analysis, and file organization analysis). A tape dump capability using existing utilities shall be provided to dump and reblock industry compatible magnetic tapes of block sizes up to 32,760 bytes.

15.4.1.3 GENERAL PURPOSE SORT-MERGE UTILITY

The system shall provide the user with the capability toperform general purpose sorting and/or merging of data files. This utility shall be executable as an independent program. In addition, the high order language shall provide access to the sort/merge utility. The sort/merge capabilities shall include, as a minimum, up to eight (8) variables length sort keys in mixed ascending and descending sequence. The capacity of the sort shall be at least one hundred thousand (100,000) variable length records.

15.4.1.4 LOAD OPERATING SYSTEM UTILITY

The system shall be capable of loading the operating system for starting operations.

15.4.1.5 EXECUTABLE MODULE UTILITY

The system shall provide for listing, verification and editing of executable load modules (i.e., object programs in executable status with all external references resolved). It shall also format, and output for inspection, executable module files including those which are part of the operating system.

15.4.2 SOFTWARE PRODUCTION AND TESTING UTILITIES

The system shall include programs to control the production of and support the creation, testing and maintenance of the software components of the system. The system shall provide the capability to create and maintain program elements in source, object and executable form. It shall provide a software control capability to test, package, and deliver program elements. Software production and testing utilities shall include the following as a minimum, the capabilities described in the subparagraph below.

15.4.2.1 COMPILER LEVEL LANGUAGE UTILITY

The capability shall be provided to translate high order language source statements into machine level code. The compiler shall produce clear and concise diagnostic messages for compile time and execution time errors. The compiler shall provide the facility for producing source code cross reference listings.

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15.5 MAINTENANCE AND DIAGNOSTIC SOFTWARE

Maintenance and diagnostic programs shall be provided for the ODAPS. Each program shall be designed to operate with the equipment in an off-line mode. Maintenance programs shall be of the following types:

(a) A system diagnostic monitor program which shall ascertain the operability of equipment and functions associated with the ODAPS.

(b) Individual diagnostic subprograms for each system element.

15.5.1 MAINTENANCE SOFTWARE SUPPORT

15.5.1.1 UTILITY ROUTINE

A load routine for all diagnostic programs furnished shall be provided. This routine shall provide a means of loading a selected test block/sector from magnetic tape/disk. Each test block/sector shall consist of a diagnostic program which shall be identified by a unique block or sector number. There shall be an inspect and change routine which provides for inspection and change of memory addresses. A.diagnostic index and an instruction set shall be maintained on tape or disk for all off-line diagnostics. The index shall be callable by the operator and the instructions shall be printed or displayed in response to a diagnostic load message. The operator shall be able to suppress the instruction printout and/or display.

15.5.1.2 SUPPORT CAPABILITIES

Support software required to maintain and utilize the maintenance software shall be provided. In addition support software used for the development, test, and maintenance of delivered maintenance software shall be provided. Test programs and supporting procedures are required to allow the program and associated data base to be exercised through all functional paths and to allow problems to be isolated and categorized for resolution. The capability must be provided to verify that new code produces only the desired results and to verify that all functional paths, including varia-tions in adaptation data, meet requirements and do not produce erroneous results to the controller.

‘5.5.2 INDIVIDUAL DIAGNOSTIC SUBPROGRAMS

The individual diagnostic subprograms shall exhibit the following characteristics:

(a) Each subprogram shall be capable of detecting 95% of all failures that are contained in program controllable networks.

(b) Each subprogram shall be capable of isolating 95% of all detected failures to the lowest plug replaceable subassembly or component.

(c) Each subprogram shall run on the selected system component when that component is normally configured in the off-line system.

(d) Each subprogram (or major test within a program) shall be capable of being recycled.

(e) Each subprogram shall be capable of being controlled by CPU select switch or operator message.

(f) The capability of selecting, with each subprogram, all of the various options, number of passes, display deletions or alterations, etc., shall be provided.

(g) The capability to display/print error and test progress message as determined by the operator.

15.5.2.1 DATA PROCESSING DIAGNOSTIC

A data processing diagnostic subprogram shall be designed to detect and isolate malfunctions occurring in any of the ODAPS processors. The subprogram shall consist of three major test segments (Processor Test, Memory Test and Input/Output Test), as a minimum, and a group of selectable test routines.

15.5.2.1.1 PROCESSOR TEST

The processor test shall diagnostically test and verify the logic comprising the control and arithmetic sections of the system processor(s). The test shall be segmented into several individual test modules, each of which shall test and verify a specific portion of the logic (e.g., index register test, shift test, subtractor/adder test, multiply test, divide test, etc.).

15.5.2.1.2 MEMORY TEST

The Memory Test shall test and verify the logic associated with main memory. The program shall consist of three tests, as a minimum:

(a) A test which shall check for the proper accessing of only the correct address:

(b) A test which shall check the ability of main memory storage to hold information; and

(c) A test which shall check the influence on an address by the state (or change in state) of the storage of the surrounding addresses (e.g., all l's, A's, O's, etc.).

15.5.2.1.3 INPUT/OUTPUT TEST

The Input/Output test shall diagnostically test and verify the logic internal to the I/O section and associated selected test channels. This test shall be segmented into several individual test modules, each of which tests and verifies a specific function or portion of the logic (e.g., external function, external interrupt, channel priority, I/O data transfer, round robin, loop back, etc.). The execution of this test shall not require that the I/O channels be disconnected.

15.5.2.1.4 SELECTABLE TESTS

The selectable tests shall diagnostically test and verify the processor logic not tested as part of the main diagnostic program because of the manual intervention required on the-part of-the operator. An example of a selectable test is a stop/jump switch or a self-verification test in the event that the self-verification test is switch selectable.

15.5.2.1.5 INTERPROCESSOR TESTS

The interprocessor tests shall test and verify interprocessor logic and communications where such capability is part of the system configuration.

15.5.2.2 FDIO

The FDIO diagnostic shall aid in the detection and isolation of malfunctions occurring in the FDIO. It shall consist of the following tests:

(a) Verification of the logic in the interface between the ODAPS and FDIO;

(b) Verification of the logic associated with data entry (keyboard, cursor, etc.). This verification shall be accomplished by program control, with display patterns previously established and documented.

(c) A display pattern test shall provide a means of determining that the FDIO displays are operating in accordance with specified quality and performance requirements. At least four display test patterns shall be provided to demonstrate all functional aspects of the display. These tests patterns shall be submitted for Government review.

15.5.2.3 PERIPHERAL EQUIPMENT DIAGNOSTICS

Diagnostic programs for each major peripheral equipment (e.g., Magnetic Tape, Disk, Line Printer, etc.) shall be provided.

15.5.2.3.1 MAGNETIC TAPE DIAGNOSTIC

The magnetic tape diagnostic program shall consist of three major test segments, as a minimum:

(a) Control Unit Test;

(b) Magnetic Tape Unit Test; and

(c) A group of selectable tests.

15.5.2.3.1.1 CONTROL UNIT TEST

The control unit test shall diagnostically test and verify the logic associated with the magnetic tape controller. Major areas included shall be, as a minimum, the response to external functions, the generation of magnetic tape status words, tape motion direction, and data transfer.

15.5.2.3.1.2 MAGNETIC TAPE UNIT TEST

The magnetic tape unit test shall diagnostically test and verify the logic associated with selected tape units. Data transfer, control signals, and the writing on, and reading from, magnetic tape shall be checked in this test, as a minimum.

15.5.2.3.1.3 SELECTABLE TESTS

There shall be at least two selectable tests. A mechanical test shall check for proper tolerance of the electrical and mechanical adjustments of the magnetic tape units. A Beginning of Tape/End of Tape/Rewind with Interlock Test shall check first for the beginning of tape warning marker, second for the end of tape warning marker and third for the magnetic tape unit to be forced to a local condition upon initiation of the rewind.

15.5.2.3.2 MAGNETIC DISK DIAGNOSTIC

A magnetic disk diagnostic program shall be provided and, as a minimum, shall consist of three major test segments:

(a) Control Unit Test;

(b) Disk Unit Test; and

(c) A group of selectable tests.

15.5.2.3.2.1 CONTROL UNIT TEST

The control unit test shall diagnostically test and verify the logic associated with the disk controller. Major areas included shall be, as a minimum, the response to external commands or functions, the generation of status words, and data transfer.

15.5.2.3.2.2 DISK UNIT TEST

The disk unit test shall diagnostically test and verify the logic associated with selected disk units. As a minimum, data transfer, control signals, and the writing on and reading from disk shall be checked in this test.

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The magnetic tape unit test shall diagnostically test and verify the logic associated with selected tape units. Data transfer, control signals, and the writing on, and reading from, magnetic tape shall be checked in this test, as a minimum.

15.5.2.3.1.3 SELECTABLE TESTS

There shall be at least two selectable tests. A mechanical test shall check for proper tolerance of the electrical and mechanical adjustments of the magnetic tape units. A Beginning of Tape/End of Tape/Rewind with Interlock Test shall check first for the beginning of tape warning marker, second for the end of tape warning marker and third for the magnetic tape unit to be forced to a local condition upon initiation of the rewind.

15.5.2.3.2 MAGNETIC DISK DIAGNOSTIC

A magnetic disk diagnostic program shall be provided and, as a minimum, shall consist of three major test segments:

(a) Control Unit Test;

(b) Disk Unit Test; and

(c) A group of selectable tests.

15.5.2.3.2.1 CONTROL UNIT TEST

The control unit test shall diagnostically test and verify the logic associated with the disk controller. Major areas included shall be, as a minimum, the response to external commands or functions, the generation of status words, and data transfer.

15.5.2.3.2.2 DISK UNIT TEST

The disk unit test shall diagnostically test and verify the logic associated with selected disk units. As a minimum, data transfer, control signals, and the writing on and reading from disk shall be checked in this test.

15.5.2.3.4.2 SELECTABLE TEST

There shall be a selectable test in the line printer diagnostic. A mechanical test shall check for proper tolerance of the electrical and mechanical adjustments of the line printer.

15.5.2.3.5 CARD READER DIAGNOSTIC

A card reader diagnostic program shall be provided and, as a minimum, shall consist of the following major test segments:

(a) Control unit Test;

(b) Selectable Test.

15.5.2.3.5.1 CONTROL UNIT TEST

The Control Unit Test shall diagnostically test and verify the logic associated with a card reader/punch controller. Major areas included in this test shall be, as a minimum, the response to external commands or functions and the generation of status words.

15.5.2.3.5.2 SELECTABLE TEST

There shall be a selectable test in the card reader/punch diagnostic. This test shall check for proper tolerance of electrical and mechanical adjustments of the card reader/punch.

15.5.3 SUPPORT HARDWARE SYSTEM

A duplicate hardware configuration of the the system is required and shall be located at the FAA Technical Center. The FAA Technical Center System must be able to support the production and standard software programs for the facility(s) involved. The FAA Technical Center must provide the capability to print, illustrate and deliver programs and related products to the field facility(s). The FAA Technical Center must provide for production and testing of new code for new functions, data base changes, and ongoing trouble-shooting of.program bugs. The FAA Technical Center must provide functional capability to support system testing to the same degree as if it were located at an ARTCC.

15.6 SYSTEM FAILURES

Precautions shall be taken, such as the periodic storage of critical data, so that recovery from partial or full system failure can be effected expeditiously. Partial failures shall result, whenever possible, in performance degradation only, rather than system-wide failure. Whenever disk storage units are used, data shall be stored in such a way so that failure of one unit shall result in no loss of data or in ODAPS performance degradation. A failed processor shall be automatically bypassed and a graceful entrance to a degraded system performance mode effected (e.g., discontinuing the Continuous Data Recording function or not accepting additional flight plans) without loss of data. Degraded modes of operations shall be defined by the contractor and subject to approval by the FAA. Marginal performance of components shall be detected where possible. No single hardware failure shall result in total system failure, or the permanent loss of communication with any system, communications facility, any device (e.g., FDIO) or peripheral (e.g., line printer). Capability shall exist to bypass failed modules by means of keyboard input at the computer control console. All changes in system status and performance shall result in messages transmitted to an adapted IOT, the line printer, and, where appropriate, to other devices. The ODAPS shall automatically recover its full operational capability following power restoration after an external power interrupt. If the duration of the power interrupt is less than 5 minutes, all system files shall be preserved and recovery shall be effected within 30 seconds. If the duration of the power interrupt is 5 minutes or more, all system programs, adaptation parameters, and constants shall be preserved, but files pertaining to messages, tasks in progress and other items related to real time shall be purged during restart.

15.7 SYSTEM SIZE

In addition to the processor peripherals elsewhere required, there shall be sufficient software capability and hardware components in each system to interface with the following:

(a) 2 AFTN telecommunications lines;

(b) 1 WMSC telecommunicaitons line;

(c) 8 standard teletype circuits

(d) 4 NORAD computer facilities;

(e) 1 ARINC network interface;

(f) 8 Non-US ARTCC;

(g) 4 FDIO CCUs which together interface with a minimum of 20 RCUs;

(h) 6 NAS Stage A ARTCCs; and,

(i) 1 NADIN telecommunications line, when available.

There shall be sufficient software capability to allow each of the FDIO control units to each interface with the maximum allowable number of CRTs, keyboards, and FSPs (FAA-E-2711).

15.8 SYSTEM CAPACITY

Each ODAPS shall have the capacity to provide for the following, as a minimum.

(a) Output for the printing of flight strips (average 75 characters per strip) at the following rates: 50 per minute (peak load); 750 per hour (peak load); 2500 per day;

(b) 300 active flight plans (An active flight plan is a flight plan for an aircraft which has departed or is airborne);

(c) Number of postable fixes - 900;

(d) Number of sectors - 10 (situation displays/PVDs);

(e) Number of FPAs - 200 (the maximum allowable FPAs for a single sector shall be 15);

(f) Number of adapted direct routes 300;

(g) Number of wind stations - 40;

16.0 HARDWARE REQUIREMENTS

The ODAPS equipment shall be designed to perform all of the flight data processing functions described in this specification.

16.1 COMPUTER SYSTEM

The ODAPS computer system shall consist of two or more general purpose central processing units, main memory, auxiliary storage, input/output channels, and peripherals. Major components of the computer system shall be commercially available with no less than 200 units in the field for at least 1 year with records to support MTBF, MTTR and reliability estimates.

16.1.1 CENTRAL PROCESSING UNIT(S)

The central processing units shall have at least a 32 bit capability (registers and data paths) with instructions capable of operating on individual words, bytes and bits. Addressing modes shall include direct, indirect and indexed. The processor(s) shall have the capability of performing floating point arithmetic operations. An efficient interrupt scheme shall be included to allow input/output and external interrupts to be handled on a priority basis. The processor(s) shall include a power failure detection feature that terminates processing and stores critical parameters from main memory to disk when power fails.

16.1.2 MAIN MEMORY

Sufficient protection shall be included to allow detection of two-bit errors and correction of single-bit errors. Data stored in main memory shall not be affected by power transients as specified in FAA-G-2100 or by power losses up to 5 minutes in duration.

16.1.3 INPUT/OUTPUT CHANNELS

A sufficient number of input/output channels to service all interfaces and peripheral devices shall be provided. The data rate capacity shall be capable of handling the worst case design load without overruns on the synchronous devices. Channels servicing high speed devices and processor communication links shall use direct memory access. A single bit error detection scheme shall be included for data transfered on the channels.

16.2 PERIPHERAL EQUIPMENT

Sufficient peripheral equipment (disk drives, magnetic tape drives, printers, card reader, input/output display devices) to satisfy the on-line and off-line processing requirements of this specification shall be provided. At least one each of the following shall be available for off-line processing: CPU, disk drive, magnetic tape device, line printer, card reader, and operator terminal with printer. The peripheral equipment shall use the same blank input media (paper, magnetic tape, cards) supplied by the Logistics Service for use by other ARTCC data processing systems. Each peripheral controller shall be dual ported (i.e., capable of being utilized by either of two computers under software control). Peripherals and their controllers shall provide error detection features. Line printers shall operate at a minimum of 300 lines per minute with a line width of 132 characters and produce at least 4 copies (i.e., 4 part paper). The line printer shall be able to print all characters capable of being printed by the FDIO flight strip printer (FAA-E-2711).

16.2.1 MAGNETIC TAPE UNIT (MTU)

The MTU shall consist of a controller and a nine (9)-track magnetic tape transport (MTT).

16.2.1.1 CONTROLLER

The controller shall provide selectable recording densities of 800 or 1600 bits per inch with both lateral and longitudinal parity checking and buffering up to 32,760 bytes.

16.2.1.1.1 FUNCTION COMMANDS

Function commands shall be accepted in the form of forced External Function (EF) command words, i.e., the magnetic tape unit shall not present an External Function Request (EFR) signal. The controller shall accept these EF command words and issue the necessary series of subcommands to a magnetic tape transport.

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16.2.2 DISK SUBSYSTEM

The basic disk subsystem shall be capable of reading, writing, and storing data and shall be comprised of a disk control unit and up to four disk drive units per control unit. The subsystem shall permit two disk drives to operate simultaneously with any track on any drive accessed in an average of 27 milliseconds or less. Disks shall have a bit error rate of not more than 1 in 10^{10} for recoverable errors and 1 in 10^{12} for nonrecoverable errors. File organization and format shall be under program control and the command structure shall permit processing with either randomly or sequentially organized files.

In addition, the subsystem shall have the following features:

(a) DISK-TO-DISK COPYING

(b) MULTIPLE TRACK OPERATION - Eliminates the need for Seek Head commands in a chain of read or search commands. The control unit shall automatically select the next sequentially numbered read/write head on the drive wihout loss of a disk revolution.

(c) ROTATIONAL POSITION SENSING - During most of the search for a record on an addressed track, the drive shall release the control unit and channel to perform other functions.

(d) ADVANCED FUNCTION CAPABILITY - At the end of a format, write operation on a disk drive; the drive unit shall release the control unit and channel to perform other functions.

(e) COMMAND RETRY - Without need for error-recovery programs, the control unit shall automatically retry improperly executed commands.

(g) STATISTICAL USAGE/ERROR RECORDING - The control unit shall maximize subsystem availability by maintaining a statistical data record of usage and error information for each logical device in the disk subsystem. Authorized maintenance personnel shall be able to use the information to identify and service minor equipment problems.

(h) DUAL PORT CAPABILITY - The subsystem shall be expandable to permit any drive in the disk subsystem to be addressed by either of two control units. This shall be accomplished by dynamic switching at the drive level. In this configuration a single cable interconnection shall allow maintenance on either control unit without recabling to any of the drives.

(i) BUFFERING - Sufficient buffering shall be provided for both input and output to prevent any loss of data that could occur because of I/O channel queuing.

16.2.2.1 DISK CONTROL UNIT

The disk control unit shall be the interface between the processor and the disk drive(s), controlling up to four disk drives. The control unit shall be expandable to interface with up to four independent processors in a time shared manner. An ENABLED/DISABLED switch shall be provided for each channel connection to allow the control unit to be placed on or off-line for that channel. An AVAILABLE indicator shall be provided to tell when the unit is operationally ready. Basic control unit functions shall include the following:

(a) Select between channels in simultaneous command situations.

(b) Decode addresses from the channel.

(c) Decode channel commands.

(d) Control the data flow, data buffering, disk drive mechanical operation, and data format to accomplish decoded channel commands.

(e) Format information (serial and parallel conversions) in accordance with CPU channel commands.

(f) Check digital information for validity during storage and retrieval.

(g) Detect and correct data errors and present error conditions to the I/O channel.

(h) Check and present status information to the I/O channel.

(i) Furnish diagnostic evaluation of the subsystem.

(j) Make parity checks in both write and read operations on data transfers between processor and controller and between controller and disk drives.

(k) Make Cyclic Redundancy Code (CRC) checks.

These functions are to be largely controlled by micro-programs permanently resident in a Control Read-Only Memory (CROM). These micro-programs shall require neither initial loading nor reloading after a power loss. The CROM shall also serve in executing diagnostics. During operations, error detection and correction shall be employed. An error-correction code shall detect errors and micro-programs shall analyze the errors to determine if they are correctable. When an error is correctable, the system shall correct the error. A usage running time meter shall be provided as well as a maintenance panel to be located inside the device to be used by authorized maintenance personnel.

16.2.2.2 DISK DRIVE

Operational characteristics of the disk drive shall possess a data rate (nominal) of 806,000 bytes/second.

16.2.2.3 OPERATIONAL CHARACTERISTICS

(a) Start-up Time (Brush Cycle, Head Load and Seek): 15 sec. maximum.

(b) Disk Rotational Speed: 3,600 RPM, ±2%.

(c) Stop Time (retract heads and stop disk motion): 15 seconds maximum.

16.2.3 PRINTER SUBSYSTEM

The Printer subsystem shall consist of a printer and controller. The subsystem shall be capable of continuous high volume printing with no preventive maintenance required other than cleaning. The printer shall accept data in the form of character codes and paper feed instructions and convert them to printout on standard business machine single and multiple part carbon forms. If the printer is a table-top unit, an operational base shall be provided.

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16.2.3.2.3 ADVANCE TO TOP OF FORM

This command shall cause the controller to advance the printer to the top of a page. Each command shall advance the paper a page at a time.

16.2.3.2.4 PRINT AND ADVANCE FORM

This command shall cause the controller to print one line of data on the line printer. In executing this command, the requested number of processor words shall be processed. Upon completing this command, the paper shall be advanced one line.

16.2.3.2.5 MASTER CLEAR AND DEMAND CONTROL

This command shall unconditionally give control of the printer to the demanding processor. This command shall also terminte any operation being performed by the controller and reset the line printer (and controller) so that a new command can be executed. This command shall cause the controller to accept print data from the processor without receiving further commands.

16.2.3.2.6 INTERRUPTS

The controller shall communicate with the processor by means of interrupts which shall be accompanied by a status word. An interrupt shall always be transmitted in response to a function command only to the processor in control. A unique indication shall be provided in the status word for the following conditions:

(a) Data parity error

(b) Function command parity error

(c) Illegal function code

16.2.3.3 MAINTENANCE CAPABILITY PANEL

The controller shall be provided with sufficient controls and indicators to permit on and off-line operation of the printer. A self-test capabilty for off-line trouble shooting and alignment shall also be provided.

16.2.4 CARD READER (CR)

The card reader shall be commercially available and shall be capable of reading standard eighty column cards. Reading shall be accomplished by photoelectric means. The card reader shall have the following characteristics: A read speed of no less than 250 cards per minute and a hopper capacity of 500 cards. The card reader transport shall shall have indicators which shall indicate error and/or status conditions such as: pick failure, timing error, cycle check, panel interlock(s) open, card jam hopper empty, stacks full, over-temperature, blown fuse (or tripped circuit breaker). The card reader controller shall control the card reader and interface the card reader with the processor via an I/O channel. The card reader controller shall provide the CPU with necessary status information including, but not limited to, status ready and status busy.

16.2.5 PLAN VIEW DISPLAY (PVD)

Government furnished PVDs (FAA Type FA7912) shall be used for the ODAPS situation display IBAGs shall be used to interface the CPUs with the PVDs. All hardware and software necessary to interface with and drive the displays shall be furnished by the contractor, to include the electrical interfaces between the CPUs and the IBAGs.

16.3 SYSTEM MODULARITY AND EXPANSIBILITY

System expansion shall be accomplished through simple plug-in techniques. In order to allow for tailoring the data processing system to an individual site's need, if necessary, and to provide for future expansion, the data processing system shall meet the following requirements.

16.3.1 PROCESSORS

The maximum number of processors to which each ODAPS can be expanded shall be equal to the number of processors used to meet the full load at the busiest site plus 25% or one, whichever is greater.

16.3.2 MAIN MEMORY

The directly accessible memory in each computer subsystem shall be field expansible in units of 256K bytes up to the maximum addressing limit for the computer.

16.3.3 PERIPHERALS EXPANSION

It shall be possible to double the disk capacity from that required by full system load by field expansion without procuring additional computer subsystems. It shall be possible to add one additional of each of the other types of peripherals without the addition of computer subsystems.

16.4 REAL TIME CLOCK

The ODAPS shall be provided with a Real Time Clock (RTC).

16.5 SPARE PARTS

The contractor shall furnish a complete list of recommended spare parts, including all components and hardware, in the form specified in FAA-G-1375a, 3.4.5. Those subassemblies necessary to satisfy the MTTR requirement given in 13.1 shall be explicitly identified.

17.0 GENERAL DESIGN REQUIREMENTS

Design and construction of all modules, assemblies and subsystems of equipment shall employ standardization of cabinets, modular packaging, printed circuit boards (PCBs), materials, processes and workmanship as specified herein. State-of-the-art technology, solid-state circuits shall be utilized to the maximum extent possible. Use of vacuum tubes in the system design is prohibited. Redundant circuits shall be designed such that either of two associated redundant circuits can fail or be serviced without affecting the other circuit. Equipment specified herein shall be built and tested in accordance with FAA-G-2100c except off-the-shelf equipment, equipment specified by FA-Type number, or unless otherwise specified.

17.1 ELECTRICAL DESIGN REQUIREMENTS

17.1.1 ELECTRICAL TRANSIENTS

The ODAPS shall not output false operational or maintenance signals as the result of applying or removing power from an on-line or off-line module,

17.1.2 POWER CONSUMPTION

The electrical design shall minimize power consumption. The contractor shall specify the total power consumed by each major ODAPS module. This shall include all operational and maintenance equipment, excluding the convenience outlets. The power factor shall not be less than 0.85 for any module.

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7.1.7 GROUNDING

7.1.7.1 GROUNDING PRACTICES

The government will furnish the AC Safety (power) ground, single point (signal) ground and multipoint (facility) ground systems as described in FAA-STD-019 at the ODPS installation sites. The contractor shall furnish all other grounds as required by this specification in accordance with FAA-STD-20. Grounding systems are isolated from each other except where they tie together at a common ground well to connect to the earth ground system. Other separate and isolated grounds required by the contrctor's design shall be provided by the contractor. Requirements of the NEC shall not be violated. Four ground networks at FAA facilities are:

(a) AC SAFETY - A common ground (green wire), derived from the AC neutral at the service entrance shall be used for power in the system.

(b) CHASSIS GROUND - All surfaces of front panels, chassis, frames and cabinets shall be at a common chassis ground potential. The ground for equipment located at operating positions shall be obtained from the chassis ground system. This connects to the facility multipoint ground system.

(c) SIGNAL GROUND - The signal return paths for control, supervision and logic type signals. Shields, conduits, and chassis shall not be used as signal returns.

(d) TRUNK CIRCUIT GROUND - A separate ground system which may be connected to the ground system for interfacing common carrier based facilities, if required. The telephone company entrance panel shall be connected to facility ground.

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17.1.8 CONDUCTED AND RADIATED ELECTROMAGNETIC INTERFERENCE

Equipment provided under this contract shall neither be adversely affected by the operation of other equipment installed in the government facilities nor be a source of interference to the operation of other equipment installed in the Government facilities (Reference FAA-STD-020). The contractor shall assume full responsibility for this requirement. Upon request, the contractor will be given access to all of the facilities in which the ODAPS is to be installed for the purpose of making measurements of the electromagnetic radiation environment. The Government does not guarantee that all similar facilities will have the same electromagnetic environment. Should any case arise in which it appears to the Government that interference exists, the contractor shall demonstrate to the satisfaction of the Government the following:

(a) The identification of the source of the interference; and

(b) The corrective action the contractor shall provide to eliminate the interference, if found in the ODAPS equipment, or the corrective action the contractor shall provide to eliminate the effect of interference if the source is found to be external to the ODAPS equipment.

(c) To prevent interference with other systems, the limits on conducted and radiated emissions in MIL-STD-461, Part 4, shall be used.

17.1.9 CABLE LENGTHS

The ODAPS shall be capable of driving other systems and FDIO control units via cables with a maximum length of 300 feet.

17.2 MECHANICAL DESIGN REQUIREMENTS

The mechanical design of the ODAPS shall be as specified in the following subparagraphs which apply to off-the-shelf, as well as newly designed, equipment unless otherwise specified.

17.2.1 CONSTRUCTION AND PACKAGING

The ODAPS and its supporting equipment shall be modularly constructed. Modules shall be implemented using plug-in circuit assemblies, card bins, and power supplies in physically independent drawers or slides in a larger cabinet or rack. The design shall provide for good accessibility by normal-sized personnel permitting convenient operation, calibration, viewing, and maintenance. Accessibility may be improved using extenders. Each unit and module shall be able to be removed from the equipment cabinet without requiring the partial or complete disassembly or removal of adjacent units, modules or cabinets. The design shall provide a neat and pleasing appearance.

17.2.1.1 PHYSICAL SIZE

The equipment specified herein shall be able to be easily installed in buildings with 36-inch (91 cm) wide doors. Individual cabinets shall not exceed 80 inches (203 cm) in height, 30 inches (76 cm) in depth or 48 inches (122 cm) in width. Smaller dimensions are desirable, providing that accessibility is not degraded. These dimensions exclude handles, cable ducts and connectors.

17.2.1.2 CABINETS

Cabinets shall be designed for front and rear access with no open spaces on the sides required. The structural strength and rigidity of the equipment units and cabinets shall be such that shipping or the prolonged extension of drawers or slides does not result in any deformation. Strength to meet the above requirements shall not be dependent on access doors, removable modules, or drawers. Cabinets and equipment shall not exceed a concentrated floor loading of 700 pounds per square foot (3400 kg/m^2) measured on a 2.5 inch (6.4 cm) diameter circle. The distributed floor load shall be less than 250 pounds per square foot (1200 kg/m^2). Adjustable leveling pads capable of variations of up to 0.5 inch (1.2 cm) shall be provided at the bases of the cabinets. All access doors shall be mounted using slip pin hinges. The opening of an access door and extending of a module shall not interfere with adjacent modules. Access to the modules and to all parts of an extended module shall be possible without undue contortion by maintenance personnel or their exposure to hazardous voltages or mechanical devices. Hooks or rings used to lift cabinets shall be removable and replaceable with suitably finished cap bolts. Blank panels shall be provided for any unused module space. All internal single or bundled wires and cables shall be suitably protected against damage.

17.2.2 CONVENIENCE OUTLETS

Two recessed duplex convenience outlets shall be provided on the bottom front of each cabinet which shall meet the requirements of FAA-G-2100c.

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17.2.7 DESIGN OF ELECTRONIC COMPONENTS

17.2.7.1 CONTROLS

All circuits shall be designed so that no damage can occur when the equipment is operated with any combination of settings of internal or external adjustments or controls without the activation of protective devices (e.g., circuit breakers). All continuous or multi-position controls shall have calibration markings to permit the setting of them to predetermined positions except where it can be demonstrated to the Government that such markings are unnecessary or impractical. Motor-driven switches and controls are prohibited.

17.2.7.2 CONNECTORS

The connectors furnished with the equipment, excluding connectors on off-the-shelf equipment, shall conform to the requirements of the following subparagraphs and to FAA-G-2100/1, 1-3.14.3 and its subparagraphs.

17.2.7.2.1 CIRCUIT CARD CONNECTORS

The number of pin connections per circuit card assembly shall be 210 or less, not including test points. The connector receptacles and the circuit card connector shall be polarized and permanently keyed such that only the correct circuit card can be inserted. Mating connectors shall be designed for repeated use and long-term reliable performance without jamming or damage as the result of frequent insertion of card assemblies. At least 1000 casual (as contrasted with "careful") insertion and removal cycles of the circuit card shall be possible without damage, degraded operation, or decreased reliability.

17.2.7.2.2 INTER-MODULE AND INTER-CABINET CONNECTORS

Cables between modules and cabinets shall be provided with separate connectors to permit separation of cabinets and removal of modules. Spare pins equal to at least 20 percent of those utilized, but not less than two of each type, shall be provided at each connection.

17.2.7.2.3 MODULE TEST POINTS

Test points, with convenient access, shall be provided for measurement and observation of voltages and waveforms needed for performance checking and maintenance.

17.2.7.4 POWER SUPPLY INDICATORS

Each circuit protected by a fuse or circuit breaker shall have some visible indication when the fuse or breaker is open.

17.2.8 CABLES

The ODAPs shall include all inter-cabinet cables, cable connectors and terminal boards, required for factory and site testing and installation of the equipment. This shall include any special purpose test cables or card extenders required for routine maintenance. Where patch panels or plugs are used in the equipment, the contractor shall provide adequate plugs or path cables as required for normal system operation. All cables and wires, harnessed or single, shall be suitably protected against chafing. Such protection shall be independent of the individual wire, cable insulation, or bracket. Cable entrances and exits shall be designed such as to enable advantageous routing of the cables between units from the standpoint of accessibility, non-interference with operating personnel and appearance of installed equipment. Where overhead racks are furnished by the Government, preferably cables shall enter and exit at the top of the equipment room cabinets. When the equipment to be supplied has cable entrances and exits at the bottom of the equipment cabinets, a suitable means shall be provided for routing cables from overhead ladders to these entrances in a concealed fashion. Where a raised floor is furnished by the Government, cable access to the cabinet will be via the raised floor plenum. Cable entrances and exits shall be provided with cover plates. All cables shall be supplied with connectors installed. Interconnecting cables shall not be looped or rolled.

17.2.9 REFERENCE DESIGNATIONS AND MARKING

The ODAPS shall have its test points, cable terminations, jacks, controls, modules, card bins, assemblies, and front panels clearly and permanently marked so they can be easily identified. The same designations shall be used as are used in the documentation.

17.2.7.4 POWER SUPPLY INDICATORS

Each circuit protected by a fuse or circuit breaker shall have some visible indication when the fuse or breaker is open.

17.2.8 CABLES

The ODAPS shall include all inter-cabinet cables, cable connectors and terminal boards, required for factory and site testing and installation of the equipment. This shall include any special purpose test cables or card extenders required for routine maintenance. Where patch panels or plugs are used in the equipment, the contractor shall provide adequate plugs or path cables as required for normal system operation. All cables and wires, harnessed or single, shall be suitably protected against chafing. Such protection shall be independent of the individual wire, cable insulation, or bracket. Cable entrances and exits shall be designed such as to enable advantageous routing of the cables between units from the standpoint of accessibility, non-interference with operating personnel and appearance of installed equipment. Where overhead racks are furnished by the Government, preferably cables shall enter and exit at the top of the equipment room cabinets. When the equipment to be supplied has cable entrances and exits at the bottom of the equipment cabinets, a suitable means shall be provided for routing cables from overhead ladders to these entrances in a concealed fashion. Where a raised floor is furnished by the Government, cable access to the cabinet will be via the raised floor plenum. Cable entrances and exits shall be provided with cover plates. All cables shall be supplied with connectors installed. Interconnecting cables shall not be looped or rolled.

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17.3.2 OFF-THE-SHELF EQUIPMENT REQUIREMENTS

Off-the-shelf equipment shall perform in accordance with the requirements of this specification on a continuous unattended basis, under the following conditions, in lieu of l-3.2.23 of FAA-G-2100/1.

OPERATING (POWER ON)

(a) O-7000 ft. altitude above sea level

(b) 40-95 degrees temperataure (cabinet intake temperature).

(c) **O-80%** relative humidity

(d) No direct air conditioning shall be required

(e) AC power input as specified.

17.4 SAFETY

17.4.1 FACILITY SAFETY

ODAPS facilities and equipment shall comply with CFR OSHA Title 29 Chapter 1910 "Safety and Health Standards."

17.4.2 NEW AND MODIFIED DESIGNS

New and modified equipment designs shall comply with **FAA-G-2100c** paragraph 3.3.7 Safety, Personnel.

17.4.3 COMMERCIAL OFF THE SHELF (COTS)

COTS equipment shall be U/L approved and listed.

18 TOOLS AND TEST EQUIPMENT

18.1 SPECIAL TOOLS

All special tools (those that are not readily available from several manufacturers) needed for installation, adjustment, or maintenance shall be provided.

18.2 TEST EQUIPMENT

A list shall be furnished of all necessary test equipment including a description, and technical and physical characteristics. The list shall contain at least two sources of procurement for each item including manufacturer, model number, options needed, if any, and listed cost.

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19.6 MANAGEMENT DOCUMENTATION

Documentation related to the contractor's management of all aspects of the ODAPS contract shall be provided as specified in the contract. Documentation shall be provided on a monthly basis or as necessary to allow detailed visibility of the contractor's program management process and of current and forecast program progress status and problems. This documentation shall emphasize problems and technical and schedule risk areas by providing detailed descriptions of these areas, describing the more reasonable alternatives considered in solving problems and minimizing risks, and shall clearly show the course-of action selected by the contractor. This documentation shall be reviewed with the Government representatives at periodic program review meetings specified in the contract and at additional meetings as deemed necessary by the Government or the contractor.

19.7 QUALITY ASSURANCE DOCUMENTATION

The quality assurance documentation requirements are specified in Section 22 herein.

19.8 INSTALLATION DOCUMENTATION

The contractor shall provide installation documentation as specified in 20.0.

20.0 INSTALLATION

The contractor shall be responsible for the shipment and installation of ODAPS and supporting equipment. The contractor shall perform site surveys in order to fulfill the requirements of this paragraph. An installation plan shall be provided that details all aspects of installation. As a minimum, it shall contain:

(a) Site information affecting installation;

(b) Installation drawings;

(c) Electrical (including power) and environmental interface definitions;

(d) Installation procedures;

(e) Installation checkout procedures that ensure the equipment is operating properly prior to formal testing; and

(f) Coordination plan for installation of ODAPS that will allow for planning interrups in ongoing work (operational and otherwise) at the facility.

21.0 APPEARANCE

The ODAPS shallbeinstalled using the same techniques(type of cable tray, duct-work, method of cable dress, etc.) used for existing computerbased equipment in the immediate vicinity of the ODAPS. The ODAPS installation willnotdegradethe overallappearance of the equipment room areas.

22.0 QUALITY ASSURANCE PROVISIONS

The contractor shall establish and maintain a quality control program in accordance with FAA-STD-013 and FAA-STD-018. The quality assurance provisions specifiedin FAA-STD-013 and FAA-STD-018 form a partofthis specification unless otherwise stated. All tests and inspections shall be performed by the contractor. The Government,however,reservestheright to witness, perform, or waive any of the test or inspections required. All tests shall be conductedin accordance with test methods and procedures stated in the Government-approved test plan. Records of tests and inspections shall be available to the Government. The contractorshallbe responsible for incorporating and testing any modification to the design found necessary during the testing of the equipments. No design changes or modifications will be allowed to the equipmentundertest without the approvalofthe Government. If any changes are approved,the Government reserves the right to require any tests to be rerun. Failure during testing shall be recordedin accordance with the Facility and Service Outage Report (FAA Handbook 6040.5). Maintenance logs shallutilize FAA Form 6030.1 and be filled out per Order SM 6030.368. Two major categories of tests are required: design verification tests and acceptance tests.

22.1 DESIGN VERIFICATION TESTS

The contractor shallconductdesigntests on the first production system to demonstrate that the requirements of this specification have been met. These tests shall be conductedinthe factory, at a Government-approved test facility, or some combination thereof. Design verification testing shall consist of:

(a) Unit tests;

(b) Subsystem tests;

(c) System tests;

(d) Reliability tests;

(e) Maintainability tests; and

(f) Environmental tests.

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(a) Unit tests;

(b) Subsystem tests;

(c) System tests;

(d) Reliability tests;

(e) Maintainability tests; and

(f) Environmental tests.

22.1.5.1 CORRECTIVE MAINTENANCE DEMONSTRATION TASKS

The contractor shall develop corrective maintenance demonstration plans in accordance with MIL-STD-471, except as modified herein. The statistical corrective maintenance demonstration tasks shall have failure modes based on information from the Failure Modes and Effects Criticality Analysis from 13.4. The procedures in Appendix A of MIL-STD-471 shall be employed by the contractor for corrective maintenance tasks. The Government will randomly select 50 tasks for the statistical corrective maintenance demonstration. The MTTE shall be less than that specified in this specification. During the corrective maintenance demonstration, any real equipment failure shall be corrected, with such a failure timed and counted as part of the demonstration.

22.1.5.2 PREVENTIVE MAINTENANCE DEMONSTRATION TASKS

The contractor shall develop a preventive maintenance demonstration plan, including all preventive maintenance tasks and the frequency at which they will be performed. These tasks shall be incorporated as a part of the Maintenance Instruction Manuals. Each preventive maintenance task shall be performed during the preventive maintenance demonstration. The time to perform these tasks shall not exceed that permitted by 13.2.1. Equipment required for operation (on-line) use shall not be pre-empted for preventive maintenance. The ability to perform preventive maintenance with the ODAPS on-line without degrading system performance shall be demonstrated.

22.1.6 ENVIRONMENTAL TESTS

The contractor shall conduct environmental tests on all new and modified equipments, including off-the-shelf equipments, to verify that these equipments can meet the environmental requirements specified in 17.3.

22.2 ACCEPTANCE TESTS

Acceptance of each ODAPS by Government shall be conditional upon delivery and installation of that system and demonstration by the contractor that it is capable of executing, in the operational environment, all functions necessary to satisfy this specification. Acceptance tests are a combination of the factory and site tests described below.

22.2.1 FACTORY TESTS

Factory tests are those unit and subsystem tests conducted within the contractor's plant to ensure that each unit, subsystem, and system meets the requirements of this specification prior to delivery.

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The contractor shall develop corrective maintenance demonstration plans in accordance with MIL-STD-471, except as modified herein. The statistical corrective maintenance demonstration tasks shall have failure modes based on information from the Failure Modes and Effects Criticality Analysis from 13.4. The procedures in Appendix A of MIL-STD-471 shall be employed by the contractor for corrective maintenance tasks. The Government will randomly select 50 tasks for the statistical corrective maintenance demonstration. The MTTE shall be less than that specified in this specification. During the corrective maintenance demonstration, any real equipment failure shall be corrected, with such a failure timed and counted as part of the demonstration.

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22.2.1 FACTORY TESTS

Factory tests are those unit and subsystem tests conducted within the contractor's plant to ensure that each unit, subsystem, and system meets the requirements of this specification prior to delivery.

22.2.2 SITE TESTS

The contractor shall conduct site tests for every system installation. Site tests shall be conducted at the unit, the subsystem and the system level. Each site test shall be designed to meet the following objectives:

(a) To verify that the installed unit, subsystem or system meets the performance requirements of this specification; and

(b) To provide the required maintenance handbook with certification procedures to enable the FAA to operate with the installed unit, subsystem or system.

These tests shall be conducted in three stages in accordance with the Government-approved installation plan:

(a) STAGE 1. - Stage 1 shall verify system integrity prior to interfacing with site equipment. Stage 1 must be successfully completed before Stage 2 can be started.

(b) STAGE 2. - Stage 2 shall be an integrated test to be conducted after the system is integrated with the site facilities.

(c) STAGE 3. - This stage shall use all operational inputs and outputs to demonstrate complete site adaptation. During this test, all functions and combinations of functions shall be exercised to show conformance with each of the systems operating requirements. All interfaces shall be operational during this stage of testing.

22.3 TEST CONDUCT

The contractor shall be responsible for conducting all tests. All test personnel shall be provided by the contractor. However, the FAA reserves the right to use FAA personnel in lieu of contractor personnel to man any operating position in the equipment configuration under test. The contractor shall conduct a test briefing and debriefing for each test and shall assure that all personnel have been properly instructed in their duties. The contractor shall make any and all additional tests necessary to demonstrate compliance with the required system performance.

22.4 FAILURE ACCOUNTABILITY

When, during the course of any test, errors or malfunctions occur, the contractor shall make entries in the appropriate logs and document each error or malfunction indicating the type, the procedures taken, and the time required to correct, and the assignment of the malfunction to the appropriate equipment or software element.

22.4.1 FAILURE CATEGORIES AND ANALYSIS

Failure categories, as specified in 5.6.1, MIL-STD-781, shall apply. Failure analysis shall be conducted as described in 5.6.2, MIL-STD-781.

The burden shall be on the contractor to show that a failure should be classified nonrelevant. In the care of a nonrelevant failure, the contractor shall inspect items such as documentation or procedures to determine whether clarification or correction of the items could reduce the risk of failure.

22.4.2 FAILURE RECORDING AND REPORTING

Failures shall be recorded on the test data forms required by FAA-STD-013.

22.4.3 ADDITIONAL TESTS

The FAA may require the contractor to repeat tests, or portions thereof, when the original tests fail to demonstrate compliance with the specification at no additional cost to the Government.

22.4.4 EQUIPMENT MODIFICATION

The contractor shall be responsible for incorporating and testing any modifications to the design necessary to meet the requirements herein. Resulting modifications to equipment shall be incorporated into each system delivered at no additional cost to the Government.

22.4.5 DOCUMENTATION UPDATING

The contractor shall update all affected documentation consistent with the standards of the original documentation as hardware and software design changes occur.

23.0 PREPARATION FOR DELIVERY

Packing and shipment of all ODAPS related equipment and spare parts shall be the responsibility of the contractor. Spare parts shall be marked, packaged, and packed in accordance with the requirements of MIL-E-17555C using level C/C, Method 3 unless air-ride padded shipment is used.

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Adapted	Contained or present in adaptation.
Adapted altitude or adapted posting altitude	An altitude, derived from adaptation to process a route segment, to be transmitted or for printing purposes.
Adapted direct route	Provides rigidly controlled fix postings for often-used flight paths between two consecutive filed fixes. It is program applied when adapted consecutive fixes are filed.
Adapted sectorization plan	Any one of a number of sector plans which may be activated by a resector (CS) message.
Adjacent center	A center whose area is adjacent to that of the center being discussed.
Air carrier	An aircraft certified by the FAA for the purpose of carrying persons or goods for hire on established routes. Also applies to an organization operating an air carrier.
Aircraft class	A grouping of aircraft types according to flight characteristics.
Airline B TTY	A teletypewriter circuit (network) to which air line operations offices are connected.
Airport	A facility which handles a high volume of IFR air traffic. It has a fix name adapted in airport adaptation with complete airport data. This airport may have one or more satellite airports associated with it.
ATS Route	A named, adapted route defined as a series of adapted fixes and junctions, e.g., A22.
Alphanumeric display	A display, on a CRT, which is composed of alphanumeric data in either tabular or nontabular form.

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Alphanumeric display	A display, on a CRT, which is composed of alphanumeric data in either tabular or nontabular form.

Blocked altitude	A range of altitudes for a proposed flight defined by the lower and upper limits of the filed altitude (e.g., 280B310). The upper limit of a blocked altitude is used for processing.
Boundary crossing point	The point where a boundary crossing between two centers occurs at a flight's altitude. For determination of boundary crossing for an adapted route, see NAS-MD-312.
Boundary crossing time	The time at which a flight is calculated to cross a center boundary.
Calculated Delay Interval (CDA)	The period of time that a flight is calculated to maneuver in the vicinity of a fix.
Calculated Time of Arrival (CTA)	The time a flight is expected to arrive over a fix (calculated by the FDP program).
Caution Alarm Information (CAI)	CAI message.
Center	An Air Route Traffic Control Center (ARTCC).
Center airspace	Synonymous with center area.
Center area	That geographical area for which an ARTCC has air traffic control responsibility and which is defined in adaptation. The air space within a center area is subdivided into fix posting areas that may be controlled by sectors within the center or delegated to approach control facilities. Center air space may overlie or underlie the adapted air space of an adjacent center.
Center B TTY	A teletypewriter circuit (network) to which ARTCC's and the Central Flow Control Facility are connected.
Climb Completion Time (CCT)	The time a departing flight is expected to reach en route altitude.
Clock time	The current time as maintained internally by the program.

Code subset	A series of beacon codes whose high order (most significant) bits stay constant.
Coded route	An adapted special-use sequence of fixes with various options that describe a route of flight identified by a unique name, which may be filed as a single route element. There are five types: **Type 0** - basic type with no special options. **Type 1** - may have airspeed adapted with each fix. **Type 2** - may have altitude, airspeed, and/or re-entry option adapted with each fix. **Type** 3 - may have time delay adapted with each fix. **Type** 4 - may have altitude, airspeed, and/or time delay option adapted with each fix. Type **1,2,** and 4 - are direction sensitive.
Composite Route System	An organized oceanic route structure, incorporating reduced lateral spacing between routes, in which composite separation is authorized.
Composite Separation	A method of separating aircraft in a composite route system where, by manage-ment of route and altitude assignments, a combination of half the lateral minimum specified for the area concerned and half the vertical minimum is applied.

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Composite Route System	An organized oceanic route structure, incorporating reduced lateral spacing between routes, in which composite separation is authorized.
Composite Separation	A method of separating aircraft in a composite route system where, by manage-ment of route and altitude assignments, a combination of half the lateral minimum specified for the area concerned and half the vertical minimum is applied.

Destination fix	The last converted fix for a flight plan if it is the destination.
Discrete beacon code	A radar beacon mode 3/A code of four octal digits in which one or both of the last two digits is other than zero. There are 4096 unique codes, but only 4032 can be used for discrete code assignment.
Display	A program-generated message or response output on a computer readout device (CRD).
Dynamic	Subject to change. Data is considered to be dynamic when it can be changed while the system is on-line.
Dynamic buffering	The capability to buffer programs between disk and main storage in order to accomplish more effective use of operational storage.
En route altitude	The altitude used for processing the segments between departure and arrival processing, or an on-line altitude used for overflights.
En route fix	All converted fixes that are not departure fixes or destination fixes.
Estimated Time En Route (ETE)	The time to traverse the entire route of flight from departure to destination.
Estimated Time of Arrival (ETA)	The time a flight is expected to arrive at its destination based on actual time of departure and estimated time en route (ETE).
Exit fix	The last fix of a standard instrument departure (SID) coded route; also the fix from which a transition is made from a SID or coded route to the transition fix.
Expired fix	An expired fix is any converted fix previous to the reference fix. (See NAS-MD-313).
External airport	An airport outside the adapted airspace of a center.

Destination fix	The last converted fix for a flight plan if it is the destination.
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Filed route	The Field 10 portion of a filed flight plan.
Filed segment	Two fixes, filed or implied, and the route between them.
FIR boundary	A four letter ICAO Location Identifier assigned to the Flight Information Region (FIR).
First order message	An initial transmittal of data (e.g., a flight plan message) for a given flight.
Fix	Any geographical point.
Fix name	. A 2-5 alphanumeric identification of a geographical point or navigation aid.
Fix Posting Area (FPA)	A three dimensional volume of air space, bounded by a series of connected line segments with altitudes, which is assigned to a sector or approach control facility. They are described in terms of latitude and longitude and converted to X-Y coordinates in units of one-eighth mile. The FPA is the basic unit of air space within the ATC system.
Fix-Radial-Distance (FRD)	Identifies a geographic point in terms of a fix name (e.g., IAD), a radial from that name (e.g., 175), and a distance from that fix (e.g., 033). The form of an FRD is IAD175035.
Fix Time Determination (FTD)	The establishment and maintenance of stored fix times for each converted fix in each flight plan in the system. This process uses speed and times filed or updated in the flight plan, geographical route and adaptation data, and stored wind data.
Flight data	All data applicable to a flight including filed flight plan, flight amendments, reported altitude, track position and velocity, and time estimates.

Filed route	The Field 10 portion of a filed flight plan.
Filed segment	Two fixes, filed or implied, and the route between them.
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Fix Time Determination (FTD)	The establishment and maintenance of stored fix times for each converted fix in each flight plan in the system. This process uses speed and times filed or updated in the flight plan, geographical route and adaptation data, and stored wind data.
Flight data	All data applicable to a flight including filed flight plan, flight amendments, reported altitude, track position and velocity, and time estimates.

Flight plan velocity	The speed and heading of a flight relative to the ground according to its flight plan and stored wind data. Ground velocity over a route segment is obtained from the times stored for the fixes at each end of the, segment and the location of the fixes.
Focal Point Fix (FPF)	Any adapted fix can be designated a focal point fix for a fix posting area (FPA). It may be outside the FPA which it serves, and it may serve more than one FPA. Each FPA must have a FPF. An FPF is usually the point to which positions calculated during direct route conversion are related.
F-Time	An estimated time over a coordination fix, for a proposed departure flight plan, which is transmitted as a result of a planned shutdown action. A flight plan received with a F-Time retains the F-Time until the F designation is explicitly changed.
Handoff fix	A predetermined geographical location over which an aircraft will transit from one area of control to another.
Hold fix	A fix designated as a result of a hold action having been entered for the fix.
Holding	A predetermined maneuver which keeps an aircraft within a specified airspace while awaiting further clearance.
Holding fix	A specified fix used as a reference point in establishing and maintaining the position of an aircraft while holding.
Hold list	A list of aircraft that are holding within the sector.

Implied fix	An intersection that is not specifically filed in a flight plan but is implied by the junction of two adapted routes, excluding preferential routes.
Inactive sector	A sector to which no fix posting areas are currently assigned.
Inbound coordination fix	Used as a common reference point between centers, or between a center and approach control area. It is received in an inter-facility flight plan message. For an approach control, the inbound coordination fix may be the inbound approach control boundary intercept point.
Inhibit transmission	To block transmission of information *to a* specific facility *or* FDEP position in a manner that provides notification to affected sectors/facilities.
Intercenter coordination fix	Used *as a* common reference point for traffic between centers. They are referred to as Outbound Coordination Fix for center being exited, and Inbound Coordination Fix for center being entered.
Interface	A communication link between two or more system components. An on-line device is considered interfaced unless it is inhibited. Interface is also used in referring to the communication link between the computer program and the user.
Internal Code	A beacon code assigned to aircraft from one or more code subsets reserved for internal departures.
Internal Departure	A flight plan with the point of departure, complete route of flight and destiation in the same ARTCC's airspace.
	NOTE: Airfiles and traffic inbound from Oceanic and non-U.S. airspace when input into the ARTCC computer (estimate messages) are considered for code assignment purposes as departures.

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Octal digit	An integer in the numeric system of notation which uses 8 as the base or radix. The octal digits are: 0, 1, 2, 3, 4, 5, 6, and 7.
Off-the-Shelf-Equipment	A unit of equipment which has been produced, sold, delivered, and has performed its designed function for at least one year after delivery at the time of proposed submission. Certified proof of sales, delivery and performance shall be furnished to the FAA contracting officer with the proposal.
On-Line	Pertains to I/O devices; interfaced with the operational program.
On-line altitude	An altitude that is sent or received as part of an intercenter message. It is sent or received as the en route altitude; however, external adaptation or nonadapted arrival logic may specify another altitude to be used for initial processing and printing.
On-line HSP	A high speed printer assigned to the operational program.
Operational computer program	That set of computer subprograms which provides selected operational functions.
Outbound coordination fix	A common reference point between centers or between an approach control area and a center. It is transmitted to an approach control or adjacent center.
Overflight	A flight that enters the center from an adjacent center and then exits from the center to one of the adjacent centers.

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Outbound coordination fix	A common reference point between centers or between an approach control area and a center. It is transmitted to an approach control or adjacent center.
Overflight	A flight that enters the center from an adjacent center and then exits from the center to one of the adjacent centers.

Reconfiguration (Automatic or Manual)	1. Automatic reconfiguration is the action by the computer program to recognize a failure and switch the failed element or device out of the operational system and replace it with a standby unit. 2. Manual reconfiguration is the same as automatic reconfiguration except that the reconfiguration is caused by an input from a supervisory position.
Reconfigure	Change the arrangement of elements.
Reference fix	A flight plan's earliest unexpired fix.
Reference time	The time associated with a flight plan's reference fix.
Referred	Output to other than the input source (pertains to error or rejection messages).
Remote device	A device which is external to the ARTCC and has input/output capability to/from the ODAPS computer. EXAMPLE: NAS facilities and Service B facilities.
Reported altitude	The last altitude/flight level at which a flight has reported.
Requested altitude	The altitude entered as Field 09 and/or printed in box 20 of a flight progress strip.
Resectorization	The act of changing the FPAs and/or sectors assigned to the various sectors according to one of the sectorization plans.
Response time	The time from the start of an operation until the time the output of the operation results.

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Response time	The time from the start of an operation until the time the output of the operation results.

Second order message	A transmitted message referencing previously transmitted data for a given flight (see First Order Message).
Sector	An altitude limited, geographical area, within an ARTCC that contains control positions.
Sector airspace	One or more contiguous fix posting areas controlled from a single control sector (i.e., the FPAs assigned to a sector). A sector's air space may overlie or underlie air space controlled by another sector or by an approach control facility.
Sector area	Synonomous with sector air space.
Sector plan	An adapted set of sector/FPA assignments which may be implemented by reference to a unique plan name. The Basic Sector Plan is the plan in which each FPA is assigned to the sector whose 2-digit identification is the same as the first two digits of the FPA identification.
Segmented airway	An airway that is noncontinuous.
Segment heading	The azimuth, relative to true north, from one converted fix along a route.
S-Line	On a direct route, an S-Line crossing point will force a fix posting for the FPA specified by the S-Line. A special section coordination line.
Source information	Data collected and assembled for the purpose of developing adaptation.
Station	A Flight Service Station or Weather Reporting Station.

Stereo Message **(SP)**	An input which supplies the aircraft identification and other necessary fields to a specified stereo record, the combination of which produces a valid flight plan.
Stereo record	A record in adaptation with a unique adapted name containing flight-plan-related data stored with permissible missing fields.
Stereo tag	A unique name, identifying a stereo route, that can be entered as the only element of Field 10 of a flight plan.
Stereo' route	A series of adapted or nonadapted routes (except preferential routes) previously defined in a flight plan by a Stereo Tag.
Stereographic projection	A coordinate set, made by placing a plane tangent to the surface of the earth and projecting the earth's surface onto this plane by lines drawn from the antipode of the point of tangency (a point on the earth's surface diametrically opposite the point of tangency) through the points on the earth's surface to be projected.
Strip coordination indicator	The identifier of the adjacent center or approach control facility which has received or should receive flight plan information.
Subcycle	The length of time that comprises both the time for a program operation and the time between two consecutive program operations.
Subjugate FPA	An FPA which is assigned to a primary FPA by means of adaptation.
Successful transmission	Reproduction by a remote or local device of transmitted output without detectable error.

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Subjugate FPA	An FPA which is assigned to a primary FPA by means of adaptation.
Successful transmission	Reproduction by a remote or local device of transmitted output without detectable error.

Unanswerable	Adapted not to receive responses; pertains only to Service B TTY stations.
Unexpired converted fix	A converted fix that is still'retained by the program; an expired fix is dropped. (See NAS-MD-313.)
Uniform time update	An output message alerting the controller that a significant time change by the same time increment, at each fix, has occurred for a given flight.
Update	A change to the flight plan as a result of an entry of new data.
Within flight	A flight that departs from an airport internal to the center area and then lands at an airport within the center without ever exiting the center area.

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Within flight	A flight that departs from an airport internal to the center area and then lands at an airport within the center without ever exiting the center area.

ABBREVIATION/ACRONYM	MEANING
CPU	Central Processor Unit
CRT	Cathode Ray Tube
CS	Resector message
CTA	Calculated Time of Arrival Digit
DA	Transmission Accepted message
DD	Departure Delay message
DM	Departure message
DOW	Days of Operation, Field 72 abbreviation
DQ	Discrete Code Request message
DR	Transmission Rejected message
DT	Data Test message
D-Time	Departure Time
DVFR	Defense Visual Flight Rules
DX	Retransmit message
EOF	End of File
EOM	End of Message
ETA	Estimated Time of Arrival
ETE	Estimated Time Enroute
FDEP	Flight Data Entry and Printout (equipment)
FDP	Flight Data Processing
FIR	Flight Information Region
FIX	Field 06 abbreviation
FL	Flight Level
FLID	Flight Plan Identification
FP	Flight Plan message

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CPU	Central Processor Unit
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FIR	Flight Information Region
FIX	Field 06 abbreviation
FL	Flight Level
FLID	Flight Plan Identification
FP	Flight Plan message

ABBREVIATION/ACRONYM	MEANING
NCP	NAS Change Proposal
nm	Nautical Miles
OCPD	Operational Computer Program Description
PC	Printout Control message
PR	Progress Report message
PS	Planned Shutdown message
QB	Beacon Code Modification message
QR	Report Altitude message
QZ	Assigned Altitude message
RAL	Requested Altitude, Field 09 abbreviation
RC	Sector Assignment Request message
RMK	Remarks, Field 11 abbreviation
RS	Remove strip message
RTE	Route, Field 10 abbreviation
sec	Seconds
S-Line	Adapted line to generate an additional posting
SOM	Start of Message
SP	Stero Flight Plan message
SPEC	Special
SPD	Speed, Field 05 abbreviation
SR	Strip Request message
TA	Accept Transfer message
TAS	Filed True Airspeed

ABBREVIATION/ACRONYM	MEANING
NCP	NAS Change Proposal
nm	Nautical Miles
OCPD	Operational Computer Program Description
PC	Printout Control message
PR	Progress Report message
PS	Planned Shutdown message
QB	Beacon Code Modification message
QR	Report Altitude message
QZ	Assigned Altitude message
RAL	Requested Altitude, Field 09 abbreviation
RC	Sector Assignment Request message
RMK	Remarks, Field 11 abbreviation
RS	Remove strip message
RTE	Route, Field 10 abbreviation
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S-Line	Adapted line to generate an additional posting
SOM	Start of Message
SP	Stero Flight Plan message
SPEC	Special
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SR	Strip Request message
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26. ODAPS PHYSICAL - FUNCTIONAL INTERFACE RELATIONSHIP

26.1 SUMMARY OF EQUIPMENT AND SERVICES TO BE FURNISHED

The equipment and services furnished under this specification shall be as required to provide, install and test the ODAPS at FAATC New York ARTCC and Oakland ARTCC in accordance with this specifica-tion and the terms of the contract schedule. Installation and test shall include the interfaces, and the interface capabilities, required for the ODAPS to operate with facilities, as described herein. The contractor shall provide all of the equipment, software, documentation. and services required to install, test and operationally implement ODAPS at FAATC, New York ARTCC and Oakland ARTCC. Anv other equipment, software, documentation, service, or any other resource necessary for proper o-eration and maintenance of the ODAPS in accordance with the requirements of this specification' and the contract schedule shall be provided even though not specifically listed bel-w.

(a) Design, procurement, configuration, and installation (including GFE) of ODAPS hardware;

(b) Central processing units;

(c) Main memory units;

(d) Input/Output (I/O) channels;

(e) Peripheral equipment;

(f) Computer Operator Terminals (I/O devices);

(g) Supervisory terminals (IOTs);

(h) Interfaces with equipment as identified herein;

(i) Operational, support. and maintenance software programs;

(j) Cables;

(k) Maintenance equipment and tools;

(1) Special test equipment;

(m) Cpare -arts;

(n) Documentation;

(o) Definition and erf-rmance of tests; and

26.2 GOVERNMENT FURNISHED FACILITIES AND EQUIPMENT

The Government furnished facilities, equipment and services will be identified in the contract schedule. Items to be identified will Include, government furnished plan view displays (PVD), interface buffer adapter generators (IBAGS) and flght data input-output (FDIO) equipment. Contractor shall be responsible for interfacing this equipment at each ODAPS site.

26.3 INTERFACES

In order to provide ODAPS with the necessary data base and to efficiently exchange flight plan data, on-line interfaces shall be required with other facilities, including en-route automation systems. All interfaces shall provide processing to insure positive disposition of all message transactions and an indication of disposition including printouts or unsuccessful transmissions.

26.4 ODAPS/FDP INTERFACE

The ODAPS/FDP physical interfaces are divided into local and remote categories.

26.4.1 ODAPS/FDP LOCAL INTERFACE

The ODAPS/FDP shall provide a local interface to the ODAPS display, local 9020, and FDIO.

26.4.2 ODAPS/FDP REMOTE INTERFACE

The ODAPS/FDP shall provide remote interfaces to external facilities. These external facilities may be geographically collocated with the ODAPS/FDP or distant (for example, WMSC, remote 9020s, ARINC, IFSS, AFTN, NORAD, appropriate Non-US and ARTCCs CARF).

26.5 MESSAGE DESCRIPTION

The NAS message types that are to be received and transmitted are specified in this specification and the appropriate NAS-MD. Message sources, contents, processing required and the results of each input message, acceptance checks and processing for route of flight, and processing required for beacon code assignment specified. The paragraphs in the En Route Stage A Computer Program Functional Specifications (CPFSs) referenced in this specification are to be considered part of this specification in so far as they apply to flight data processing functions and ODAPS.

26.5.1 INPUT AND OUTPUT

With the exception of situation displays (PVDs) keyboards and flight strip printers at oceanic sector positions input and/or output from, the ODAPS shall generally be with the 9020 CCCs, ARINC, WMSC, AFTN, NORAD facilities CARF, IFSS and appropriate non-US ARTCCs.

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26.6 PRE-NADIN TIMEFRAME/PHYSICAL INTERFACE

Prior to the full operational implementation of NADIN the ODAPS/FDP remote interfaces will be serviced by a dedicated set of teletype (TTY) and low speed (2400 bps) digital links. The following facility/system interfaces are required as follows:

26.6.1 DOMESTIC ARTCC AUTOMATION SYSTEMS

The ODAPS shall interface with up to six (6) ARTCC automation systems for the exchange of flight plan data identical to that described in Section 2, NAS-MD-315. A full duplex digital link will connect with the six (6) 9020 CCCs and ODAPS/FDP APPENDIX 1 and 2 describes these interfaces.

26.6.2 ARINC

ODAPS shall interface with the ARINC data net and accept messages in ARINC format. Data will be extracted from Progress Report (PR) messages and used for updating ODAPS data base. Details concerning use and validation of the PR are contained in Paragraph 4.2. Provisions for future interface with enhancements in the ARINC communications addressing and reporting systems (ACARS) shall be provided when sufficient data is available to define the interface and data formats. A half duplex TTY link will connect ARINC central operations with ODAPS/FDP. APPENDIX 3 describes this interface.

26.6.3 SERVICE A WEATHER NETWORK/WMSC

ODAPS shall interface with WMSC. This interface shall be direct and discrete. AFTN includes the interface with the National Weather Service for winds aloft data. A half duplex TTY link will connect the Weather Messages Switching Center (WMSC) with ODAPS/FDP. APPENDIX 4 describes this interface.

26.6.4 SERVICE B NETWORK

A half duplex TTY link will connect the Area B Data Interchange System switch serving the IFSS/FSS facilities with ODAPS/FDP. APPENDIX 5 describes this interface.

26.6.5 AERONAUTICAL FIXED TELETYPEWRITER NETWORK (AFTN)

ODAPS shall interface with the aeronautical fixed telecommunications network (AFTN). ICAO formatted flight plans shall be accepted. AFTN is an integrated worldwide teletypewriter communications systems of fixed circuits. The AFTN provides communications service for not only aircraft movements, but also administrative messages and metero-logical data between FAA facilities and between FAA and ICAO nation facilities. The ODAPS shall interface with the AFTN, primarily for the exchange of flight plans, and flight data related messages. A half duplex TTY link that is part of the AFTN will connect non-US ARTCC and other ICAO user facilities with ODAPS/FDP. Some AFTN traffic may come via the Area B link if it has been switched at NATCOM. APPENDIX 6 describes this interface.

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26.7 NADIN

The NADIN will replace the AFTN for the exchange of messages concerning international aircraft movements, administrative messages, and meterological data since the implementation schedule for NADIN is not firm, ODAPS interface with NADIN will not be accomplished until NADIN is fully operational and able to assume full responsibility for international and domestic air movements and weather data. APPENDIX 12 describes the NADIN interface. Details of the ODAPS interface with NADIN are contained in this specification.

In the case of NADIN, the ODAPS shall be capable of procesing the message types described in ICAO Document 4444-RAC/501/11, (Procedures for Air Navigation Services) and in ICAO Annex 10, Volume II. The contractor shall provide the interface between the ODAPS and NADIN so that the messaages described herein can be transmitted and received.

26.8 POST-NADIN TIMEFRAME/PHYSICAL INTERFACE

When NADIN is implemented or if NADIN becomes fully operational during implementation of ODAPS, NADIN will provide some message/packet switched service to the ATC system with custom routing features (virtual circuits, etc). The interface topology for ODAPS/FDP will require a change to accomodate the NADIN. APPENDIX 11 describes the NADIN interface. Conditions at that time NADIN becomes fully operational should be as follows:

(a) NADIN will absorb the message traffic from the AFTN for the exchange of messages concerning international aircraft movements. NADIN will also absorb the message traffic from Area B and Service A Weather links. A local NADIN concen-trator will provide the ODAPS/FDP interface.

(b) The NADIN concentrator assumes the message switching function for the IFSSs, and for all multipoint and point-to-point circuits.

(c) The ODAPS will interface with NADIN for all communications with the 9020 CCCs, non-US ARTCCs, NORAD facilities, CARF and ARINC for interfacility message traffic.

(d) The retention of a direct interface between ODAPS and the 9020 CCCs shall be necessitated during the period of change-over to NADIN.

200.0 ODAPS/FDP - REMOTE 9020 CCC INTERFACE CONTROL DOCUMENT

200.1 INTRODUCTION

200.1.1 PURPOSE

The information contained herein describes the interface control requirements for communications links between the remote NAS 9020 Central Computer Complex (CCC) at an Air Route Traffic Control Center and ODAPS/FDP.

200.1.2 SCOPE

This paper addresses interface control requirements at three levels:

(a) Physical, i.e., the communications lines;

(b) Link, i.e., the control of transmissions; and

(c) Message, i.e., the actual data transmitted.

200.1.3 SYSTEM OVERVIEW

The ODAPS/FDP communications considered here are of two basic types:

(1) Output messages, i.e., transmissions from the CCC to the ODAPS/FDP;

(2) Input messages, i.e., transmission from the ODAPS/FDP to the CCC.

ODAPS/FDP functions related to output messages from the CCC to the ODAPS/FDP are:

(a) Determination of output mesage acceptability and the initiation received;

(b) Buffering of acceptable output messages for subsequent transmission to terminals; and

(c) Conversion of output message text from EBCDIC to ASCII code.

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(b) Buffering of acceptable output messages for subsequent transmission to terminals; and

(c) Conversion of output message text from EBCDIC to ASCII code.

200.2 PHYSICAL CONTROL LEVEL

This ICD addresses the method of interfacing a Remote NAS 9020 to ODAPS in order to provide full duplex communications between the Remote NAS 9020 CCCs and ODAPS/FDP. This method uses INTI/INTO adapters for the interface with the Remote 9020 CCCs.

201.0 INTI/INTO

The Interfacility Input and the Interfacility Output adapters are generally used to provide NAS to NAS and NAS to ARTS communications. This data is bit serial EBCDIC. The physical connection between each ODAPS/FDP control unit and the Remote 9020 CCC shall be via mode and telephone line through INTI/INTO adapter to the 9020 computer.

(a) PROTOCOL CONVERTER UNIT

The PCU was developed by the Department of Transportation at the Transportation Systems Center, Cambridge, Mass. 02142. This device is located at the ODAPS/FDP site and appears to the NAS 9020 PAM adapters as a normal Interfacility Communications Network.

(b) AIR LAND SYSTEMS CONVERTER

Air Land Systems Corporation, 2710 Prosperity Avenue, Fairfax, Va. 22031 has developed a device that interfaces with the INTI/INTO adapters and performs the same functions as the Protocol Converter Unit developed by TSC.

201.1 INTENT

This document defines the interface between the IBM 9020 computers and the ODAPS Computer communication network. This interface allows the NAS enroute facilities to transmit flight data into the ODAPS network, and receive oceanic flight advisories. The same type interface also could allow other ARTCC computer functions to communicate with the ODAPS network.

201.2 GENERAL

This document describes or references the hardware, software and the operational elements that are necessary to establish communications between the ODAPS and the various 9020 computer complexes.

200.2 PHYSICAL CONTROL LEVEL

This ICD addresses the method of interfacing a Remote NAS 9020 to ODAPS in order to provide full duplex communications between the Remote NAS 9020 CCCs and ODAPS/FDP. This method uses INTI/INTO adapters for the interface with the Remote 9020 CCCs.

201.0 INTI/INTO

The Interfacility Input and the Interfacility Output adapters are generally used to provide NAS to NAS and NAS to ARTS communications. This data is bit serial EBCDIC. The physical connection between each ODAPS/FDP control unit and the Remote 9020 CCC shall be via mode and telephone line through INTI/INTO adapter to the 9020 computer.

(a) PROTOCOL CONVERTER UNIT

The PCU was developed by the Department of Transportation at the Transportation Systems Center, Cambridge, Mass. 02142. This device is located at the ODAPS/FDP site and appears to the NAS 9020 PAM adapters as a normal Interfacility Communications Network.

(b) AIR LAND SYSTEMS CONVERTER

Air Land Systems Corporation, 2710 Prosperity Avenue, Fairfax, Va. 22031 has developed a device that interfaces with the INTI/INTO adapters and performs the same functions as the Protocol Converter Unit developed by TSC.

201.1 INTENT

This document defines the interface between the IBM 9020 computers and the ODAPS Computer communication network. This interface allows the NAS enroute facilities to transmit flight data into the ODAPS network, and receive oceanic flight advisories. The same type interface also could allow other ARTCC computer functions to communicate with the ODAPS network.

201.2 GENERAL

This document describes or references the hardware, software and the operational elements that are necessary to establish communications between the ODAPS and the various 9020 computer complexes.

202.1.1 INTERFACILITY OUTPUT ADAPTER

The Interfacility Output Adapter (INTO) matches the interface requirements of a Stelma Type III IFDS, as described in Reference 3. The INTO adapter serially transfers an eight bit byte (plus odd parity) received from the 9020 Computer to the PCU. The PCU does error checking, translates from EBCDIC to ASCII, and transmits the data to the ODAPS communications processor.

202.1.1.1 IDLE PATTERN

When the INTO adapter is not selected to transmit a message, the adapter continously sends alternating zero and one bits. Between successive messages transmitted by the INTO adapter, the number of idle bits may be any positive integer, including zero.

202.1.1.2 SYNC PATTERN

When the INTO adapter is selected to transmit a message, the sync pattern is transmitted first. The sync pattern generated by the INTO adapter is seventeen consecutive zero bits followed by one bit. Since the last idle bit transmitted before the sync pattern may have been either a one or a zero, the PCU must recognize a sync pattern of either seventeen or eighteen zero bits followed by a one bit. Nineteen or more consecutive zero bits is an error condition and must not be mistaken for a sync pattern. If this error condition is recognized, the PCU shall transmit a "Dead Line" control code to the ODAPS Communications processor (SEE SECTION 2.2.6). The PCU must always recognize a valid sync pattern from the INTO adapter, even in the midst of an error-free message. Upon receipt of a sync pattern, the PCU shall immediately prepare to process the new message.

202.1.1.3 FORMAT OF EBCDIC DATA

After transmitting the sync pattern of seventeen zero bits and a single one bit, the INTO adapter will transmit the message. Each byte of the message is coded in EBCDIC. The order of transmission is an odd parity bit followed by eight data bits, most significant bit first. There is no time delay between bit 7 of one byte and the parity of the next byte.

202.1.1.4 LRC

Of the 256 possible EBCDIC data codes, 254 are available for use as data characters. (Only 128 codes are translatable into ASCII; see APPENDIX B.) Two EBCDIC codes are assigned for use as control codes. The LRC Prepare code B3 (10110011) and EOM code Bl (10110001) are used throughout all NAS interfaciity data transfer systems for Longitudinal Redundancy Check Prepare and End of Message.

Each data byte transmitted by the INTO adapter updates an eight-bit LRC register within the adapter. The update consists of a bit-wise exclusive or of the data byte into the LRC register. The parity bit is not updated, only the data bits. The LRC register is cleared to all zero bits at the start of a message. Each byte in the message is checked for an LRC Prepare character. Detection of an LRC Prepare character will indicate that the LRC is to be transmitted next. After the LRC Prepare character has updated the LRC register and has been transmitted, the adapter will transmit the contents of the LRC register. The LRC register is cleared after its contents are transmitted.

202.1.1.5 EOM

The last byte of the message is the End of Message code Bl (10110001). After the EOM code is transmitted, the adapter will transmit either a new sync pattern or idle bits. See Section 4 for example of the format of messages.

202.1.1.6 9020/INTO ERRORS

If the INTO adapter detects a parity error when it receives an output data byte from the 9020, the adapter changes the parity bit and transmits the data byte to the PCU with correct parity. However, the next LRC character will be completed before being transmitted. In this way, the PCU is notified of the detected error.

After the sync pattern, every byte of the message must follow with no delay betwen bytes. If the 9020 fails to provide the next byte when the adapter requires it, an Overrun condition results. The adapter does not have the ability to fill time gaps in the message stream with SYNC characters. When the adapter recognizes an Overrun condition, the adapter transmits a byte of none zero bits (i.e., even parity plus eight zero bits), and terminates transmission of the message. In this case, there must be at least a single one bit of idle code before the next Sync pattern, or the next message will be lost.

When the PCU recognizes an error condition, it shall send a control code to the ODAPS (SEE SECTION 2.2.6).

202.1.1.4 LRC

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When the PCU recognizes an error condition, it shall send a control code to the ODAPS (SEE SECTION 2.2.6).

202.1.2.1 IDLE PATTERN

When the PCU is not transmitting a message to the INTI adapter, the continuously sends alternating one and zero bits. Between successive messages transmitted by the PCU, the number of idle bits may be any positive integar.

202.1.2.2 SYNC PATTERN

The sync pattern accepted by the INTI adapter is seventeen or eighteer consecutive zero bits followed by a one bit. The sending PCU sends a sync code containing 17 zero bits, but the last transmitted idle bit II have also been a zero bit. The adapter will monitor the Data In Line constantly for this sync pattern. When the sync pattern is detecte, t next nine-bits received constitute the first byte of the message. If adapter is not selected to read by the time the byte is assembled, the sync condition is reset and the line monitoring resumes. The sync pattern counter is also reset if a 19th consecutive zero bit is receiv A new count will not be started until the next one bit has been receiv

202.1.2.3 FORMAT OF EBCDIC DATA

The data transmitted to the INTI is described in SECTION 2.1.1.3.

202.1.2.4 LRC

The LRC Prepare character and LRC are described in SECTION 2.1.1.4. E byte assembled updates an eight bit LRC register. The parity bit is updated; only the data bits. Each byte assembled is checked for an LR Prepare character. When this character is detected, it is sent to the 9020 multiplexer channel and the next character assembled is assumed to be the LRC character. The received LRC is compared with the accumulate adapter LRC and the result of the compare, which appears as an exclusi or, is sent to the 9020. If the two LRC characters are identical, the result will be an all zero byte. If any bit position in two characters differs, a one will appear in that bit position of the LRC byte sent tc the 9020. In this case, a LRC error flag is set by the adapter to be read by the 9020. The LRC register is cleared after the LRC byte is se to the 9020.

202.1.2.5 EOM

Each byte received by the INTI adapter is checked for being a End of Message (EOM) character (10110001). After this character is detected a passed to the 9020, the INTI will return to its idle condition. See SECTION 4 for examples of the format of messages.

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202.1.2.5 EOM

Each byte received by the INTI adapter is checked for being a End of Message (EOM) character (10110001). After this character is detected a passed to the 9020, the INTI will return to its idle condition. See SECTION 4 for examples of the format of messages.

202.2.1 IDLE/SYNC PATTERN

When no message is being transferred, the idle condition on the data l shall be continous SYNC codes (11111 0000. Including odd parity).

202.2.2 BEGINNING OF MESSAGE

The beginning of a message shall be indicated by the sequence SYNC SYT SOH. The SOH (Start of Header) code is 11010 1010, including odd par:

202.2.3 FORMAT OF ASCII DATA

Immediately after the SOH code, the message characters are sent. Each byte of the message is coded in ASCII, plus one control code bit, plus odd parity bit. The control code bit is described in SECTION 2.2.6. order of transmission is seven ASCII data bits (Least Significant Bit first), then the control code bit, followed by an odd parity bit. Thr is no time delay between the parity bit of one character and the first bit of the following character.

202.2.4 LRC

Each data byte'updates an eight-bit LRC register at each end of the communication link. (That is, one LRC register at the sending end, p another LRC register at the receiving end). Only the data bits update the LRC registers, not the parity bit. The update consist of a bit-w exclusive or of the data byte into the LRC register.

Each byte of the message is checked for an LRC Prepare character. Detection of the LRC Prepare character indiates that the LRC is to be transmitted next. After the LRC Prepare Character has updated the LRC register and has been transmitted, the sending device shall transmit contents of the LRC register. The receiving device shall compare the received LRC character to the contents of its LRC register. If the L values are different, the message is asssumed to contain errors. The registers are cleared after the LRC transmission/ comparision.

202.2.5 END OF MESSAGE

The end of the message is indicated by a SYNC code. There is no special EOM code on the PCU/ODAPS link. The SYNC code at the end of a message may be the first character of the SOH sequence that is described in SECTION 2.2.2.

202.2.6 PCU/ODAPS ADAPTER ERRORS

The control characters are used on the PCU/ODAPS adapter link for message formatting, error reporting, an error recovery. The message codes (SYNC, SOH, and LRC prepare) are described above. The other control codes are used for error reporting or error recovery. When the PCU recognizes an error condition, the PCU sends a single control code error report to the ODAPS adapter. If the frequency of errors is above a threshold, (to be defined) an error message will be sent by the ODAPS to a terminal for manual intervention.

202.2.6.1 CONTROL CODE CHARACTERS

The Control Code Characters are distinguished from the data characters by having the MSB set to one. Data characters have the MSB set to zero. The Control Code Characters have the same format as the data characters, including one bit for odd parity.

1000 0000	9020 INTO Overrun
1000 0010	Dead Line from 9020
1010 1010	SOH
1011 0011	LRC Prepare
1011 0100	Untranslatable Character
1011 0101	Parity Error in Data from 9020
1111 0000	SYNC
1111 1111	Rehunt for SYNC

02.2.6.2 CONTROL CODE USE

The use of SYNC, SOH, and LRC Prepare are described in SECTIONS 202.2.1, 202.2.2, 202.2.4, and 202.2.5.

When the PCU and ODAPS adapter are initialized, each shall send fifteen "Rehunt for SYNC" characters (i.e. 135 consecutive one bits) followed by SYNC characters. The receiving device will immediately go into the SYNC-hunt mode.

If a device receiver loses synchronization with the corresponding transmitter, it shall go into SYNC-hunt mode. There are several ways for a computer to recognize that synchronization has been lost. The following two methods are to be implemented:

(a) A block of 20 characters is received that contains more than 4 parity errors.

(b) A character of all one bits is received.

202.2.5 END OF MESSAGE

The end of the message is indicated by a SYNC code. There is no special EOM code on the PCU/ODAPS link. The SYNC code at the end of a message may be the first character of the SOH sequence that is described in SECTION 2.2.2.

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92.2.7 ODAPS ADAPTER ELECTRICAL INTERFACE

The electrical interfaces for the ODAPS adapter, PCU, and any associated modems and multiplexers shall conform to the EIA RS-232-C standard (Reference 7) for voltage, current, impedance, connector typed and pin configuration.

Therefore a binary one, "mark," is a negative voltage; binary zero, "space," is a positive voltage. The interface will be bit-serial, synchronous, at a data rate of either 2400 or 4800 bits per second.

(a) RECEIVE DATA LINE

The signal on this line is an input to the ODAPS adapter, and is used to present a one bit or a zero bit to the ODAPS adapter.

(b) TRANSMIT DATA LINE

The signal on this line is an output from the ODAPS adapter, and is used to transmit a one bit or a zero bit.

(c) RECEIVE CLOCK LINE

The signal on this line is an input to the ODAPS adapter, and is used to gate data from the Receive Data Line into the ODAPS adapter. The data is sampled on the negative-going edge of the clock.

(d) TRANSMIT CLOCK LINE

The signal on this line is also an input to the ODAPS adapter, and is used to gate data from the ODAPS onto the Transmit Data Line. The data is shifted on the positive-going edge of the clock.

Both of these clock lines are active at all times, without regard to data being present.

202.3.1 The ODAPS network shall be interconnected via modems with the following characteristic:

(a) Synchronous, full duplex.

(b) Support data rates of 2400, 4800, and 9600 bits per second, switch selectable or programmable.

(c) Allow (but do not require) the clocking signals to be provided by an external source at one end (i.e., "the terminal"). This will allow the PBox to control timing exactly.

(d) Reliable i.e., long Mean Time Between Failures, quick service available for repairs, short Mean Time to Repair.

(e) Operate over voice-grade lines (SEE SECTION 202.4)

(f) Should be able to support or perform local and remote diagnostics to help pinpoint problems and assure system reliability.

202.3.2 The ODAPS network may use communications multiplexers to reduce line costs and/or increase the operational reliability of the communications network. Whatever multiplexers are selected, if any, will be transparent to the devices that are sending and receiving the date.

202.4 COMMUNICATION LINES

The transmission medium for each data channel is a voice-grade' Type 3002, telephone line. This is a point to point, full duplex, "4-wire" circuit. The type of conditioning required, if any, will be specified after the modems are selected,

202.5 PCU

An overview of the function and capability of the PCU was given in SECTION 1. The PBox does the conversion between two different protocols, one used by the INTO/INTI adapters, and the other used by the ODAPS communications processor. These protocols were previously described. The overall format of messages is given in SECTION 204. This section will discuss the processing of messages, in each direction, by the PCU.

202.5.1 MESSAGES FROM ODAPS TO 9020

Data from the ODAPS adapter shall be received in USART, and transferred to the PCU microprocessor, a byte at a time, on an interrupt basis. Data to the 9020 shall be transmitted via a USART, on an interrup basis.

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(e) Operate over voice-grade lines (SEE SECTION 202.4)

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202.5.1 MESSAGES FROM ODAPS TO 9020

Data from the ODAPS adapter shall be received in USART, and transferred to the PCU microprocessor, a byte at a time, on an interrupt basis. Data to the 9020 shall be transmitted via a USART, on an interrup basis.

202.5.2 MESSAGES FROM 9020 to ODAPS

The PCU uses a USART to receive data from the 9020 INTO adapter. The PCU also uses a USART to transmit data to the ODAPS adapter.

202.5.2.1 IDLE PATTERN

See SECTIONS 2.1.1.1 and 2.2.1.

202.5.2.2 SYNC PATTERN

See SECTIONS 202.1.1.2 and 202.2.2. Note that the PCU must always recognize the SYNC Pattern from the INTO adapter, even within an error-free message. When the SYNC Pattern is received, the PCU shall immediately begin to process the new message.

The SYNC code is used in the PCU/ODAPS interface to fill the time between messages.

202.5.2.3 FORMAT OF DATA

See SECTION 202.5.1.3.

202.5.2.4 LRC

See SECTION 2.1.1.4 and 2.5.1.4.

202.5.2.5 EOM

See SECTION 202.1.1.5 and 202.2.5. When the PCU receives EOM from the INTO adapter, the PCU returns to its idle condition, and transmits SYNC codes to the ODAPS adapter.

202.5.2.6 9020/PCU ERRORS

If a character from the INTO adapter is received with a parity error, the PCU shall do the following:

(a) Translate the 8-bit data byte into the "parity error" control code (1011 0101).

(b) Transmit the byte to the ODAPS adapter with correct parity.

(c) Complement the next LRC character sent to the ODAPS adapter.

202.5.2 MESSAGES FROM 9020 to ODAPS

The PCU uses a USART to receive data from the 9020 INTO adapter. The PCU also uses a USART to transmit data to the ODAPS adapter.

202.5.2.1 IDLE PATTERN

See SECTIONS 2.1.1.1 and 2.2.1.

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See SECTION 202.5.1.3.

202.5.2.4 LRC

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(b) Transmit the byte to the ODAPS adapter with correct parity.

(c) Complement the next LRC character sent to the ODAPS adapter.

/

204.0 EBCDIC - ASCII CODE TRANSLATION

This translation table shows the ?96 character USA/Canada EBCDIC Code, and is an upward-compatible extension of the translation table on Page 3-5 of NIS-MD-781 (Reference 5). USA/Canada EBCDIC is the code used internally by both the IBM 9020 and the IBM 4341.

This translation table is not fully compatible with the table in the NADIN specification, NAS-MD-750 (Reference 6), which uses the "International EBCDIC code." The only differences, from typing errors, are in the symbols and names associated with the following four EBCDIC codes:

EBCDIC CODE	USA/CANADA (9020)		INTERNATIONAL (NADIN)	
4A	¢	CENT SIGN	[	LEFT BRACKET
5A	!	EXCLAMATION MARK	]	RIGHT BRACKET
6A	¦	BROKEN VERTICAL LINE	|	SOLID VERTICAL LINE
4F	|	SOLID VERTICAL LINE	!	EXCLAMATION MARK

The standard ASCII code set does not include the symbols CENT SIGN or BROKEN VERTICAL LINE. The USA/Canada EBCDIC code set does not include the symbols LEFT BRACKET or RIGHT BRACKET. In the interest of allowing unambiguous translation and message interpretation, this table assigns a correspondence between EBCDIC CENT SIGN and ASCII LEFT BRACKET, and likewise between EBCDIC BROKEN VERTICAL LINE and ASCII RIGHT BRACKET.

204.0 EBCDIC - ASCII CODE TRANSLATION

This translation table shows the 96 character USA/Canada EBCDIC Code," and is an upward-compatible extension of the translation table on Page 3-5 of NIS-MD-7811 (Reference 5). USA/Canada EBCDIC is the code used internally by both the IBM 9020 and the IBM 4341.

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4A	¢	CENT SIGN	[	LEFT BRACKET
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6A	¦	BROKEN VERTICAL LINE	|	SOLID VERTICAL LINE
4F	|	SOLID VERTICAL LINE	!	EXCLAMATION MARK

The standard ASCII code set does not include the symbols CENT SIGN or BROKEN VERTICAL LINE. The USA/Canada EBCDIC code set does not include the symbols LEFT BRACKET or RIGHT BRACKET. In the interest of allowing unambiguous translation and message interpretation, this table assigns a correspondence between EBCDIC CENT SIGN and ASCII LEFT BRACKET, and likewise between EBCDIC BROKEN VERTICAL LINE and ASCII RIGHT BRACKET.

ASCII CODE	EBCDIC CODE	SYMBOL	NAME
2E	4B	.	PERIOD
2F	61	/	SLANT
30	F0	0	ZERO
31	F1	1	ONE
32	F2	2	TWO
33	F3	3	THREE
34	F4	4	FOUR
35	F5	5	FIVE
36	F6	6	SIX
37	F7	7	SEVEN
38	F8	8	EIGHT
39	F9	9	NINE
3A	7A	:	COLON (CLEAR WEATHER SYMBOL)
3B	5E	;	SEMI COLON (SCATTERED WEATHER SYMBOL)
3C	4C	<	LESS THAN SIGN
3D	7E	=	EQUAL SIGN
3E	6E	>	GREATER THAN SIGN
3F	6F	?	QUESTION MARK (OVERCAST WEATHER SYMBOL)
40	7C	@	AT
41	C1	A	UPPER CASE ALPHABETICS
42	C2	B	
43	C3	C	
44	C4	D	
45	C5	E	
46	C6	F	
47	C7	G	
48	C8	H	
49	C9	I	
4A	D1	J	
4B	D2	K	
4C	D3	L	
4D	D4	M	
4E	D5	N	
4F	D6	O	
50	D7	P	
51	D8	Q	
52	D9	R	
53	E2	S	
54	E3	T	
55	E4	U	
56	E5	V	
57	E6	W	
58	E7	X	
59	E8	Y	
5A	E9	Z	
5B	4A	¢ or [	CENT SIGN, LEFT BRACKET
5C	E0	\	REVERSE SLANT
5D	6A	¦ or]	BROKEN VERTICAL LINE, RIGHT BRACKET
5E	5F	^	UPWARD ARROWHEAD, CIRCUMFLEX
5F	6D	_	UNDERLINE

ASCII CODE	EBCDIC CODE	SYMBOL	NAME
2E	4B	.	PERIOD
2F	61	/	SLANT
30	F0	0	ZERO
31	F1	1	ONE
32	F2	2	TWO
33	F3	3	THREE
34	F4	4	FOUR
35	F5	5	FIVE
36	F6	6	SIX
37	F7	7	SEVEN
38	F8	8	EIGHT
39	F9	9	NINE
3A	7A	:	COLON (CLEAR WEATHER SYMBOL)
3B	5E	;	SEMI COLON (SCATTERED WEATHER SYMBOL)
3C	4C	<	LESS THAN SIGN
3D	7E	=	EQUAL SIGN
3E	6E	>	GREATER THAN SIGN
3F	6F	?	QUESTION MARK (OVERCAST WEATHER SYMBOL)
40	7C	@	AT
41	C1	A	UPPER CASE ALPHABETICS
42	C2	B	
43	C3	C	
44	C4	D	
45	C5	E	
46	C6	F	
47	C7	G	
48	C8	H	
49	C9	I	
4A	D1	J	
4B	D2	K	
4C	D3	L	
4D	D4	M	
4E	D5	N	
4F	D6	O	
50	D7	P	
51	D8	Q	
52	D9	R	
53	E2	S	
54	E3	T	
55	E4	U	
56	E5	V	
57	E6	W	
58	E7	X	
59	E8	Y	
5A	E9	Z	
5B	4A	¢ or [	CENT SIGN, LEFT BRACKET
5C	E0	\	REVERSE SLANT
5D	6A	¦ or]	BROKEN VERTICAL LINE, RIGHT BRACKET
5E	5F	^	UPWARD ARROWHEAD, CIRCUMFLEX
5F	6D	_	UNDERLINE

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400.0 ODAPS - SERVICE A WEATHER NETWORK INTERFACE CONTROL DOCUMENT

400.1 INTRODUCTION

400.1.1 PURPOSE

The information herein describes the interface control requirements for communication between the Service A Weather Network and ODAPS/FDP. The intent is to provide for the design, implementation and interfacing of Service A Weather and ODAPS/FDP.

400.1.2 REFERENCES

(a) To be furnished.

400.1.3 ORGANIZATION

The Service A Weather network currently transmits weather information to ARTCCs and airline offices.

400.1.4 TECHNICAL SUMMARY

The Service A Weather network will be used by the ODAPS/FDP data base for fix time calculation and weather infomation. Weather information shall consist of wind data.

400.2 HARDWARE CHARACTERISTICS

400.2.1 EQUIPMENT REQUIRED

This document does not specify the detailed hardware interface to link the Service A Weather the ODAPS/FDP.

400.2.2 CURRENT-LOOP OPERATION

Terminal equipment normally will operate on 60 mA loops, but nothing in this document shall prevent the common carrier providing the service to supply some other arrangement. The ODAPS contractor may provide low-level (RS-232) signaling between the ODAPS and Service A Weather as long as such arrangements are in agreement with tariff provisions. This approach may be desirable from an overall system viewpoint to allow easy conversion of low-speed telegraph I/O ports to medium-speed I/O ports at a later date.

400.0 ODAPS - SERVICE A WEATHER NETWORK INTERFACE CONTROL DOCUMENT

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400.1.1 PURPOSE

The information herein describes the interface control requirements for communication between the Service A Weather Network and ODAPS/FDP. The intent is to provide for the design, implementation and interfacing of Service A Weather and ODAPS/FDP.

400.1.2 REFERENCES

(a) To be furnished.

400.1.3 ORGANIZATION

The Service A Weather network currently transmits weather information to ARTCCs and airline offices.

400.1.4 TECHNICAL SUMMARY

The Service A Weather network will be used by the ODAPS/FDP data base for fix time calculation and weather infomation. Weather information shall consist of wind data.

400.2 HARDWARE CHARACTERISTICS

400.2.1 EQUIPMENT REQUIRED

This document does not specify the detailed hardware interface to link the Service A Weather the ODAPS/FDP.

400.2.2 CURRENT-LOOP OPERATION

Terminal equipment normally will operate on 60 mA loops, but nothing in this document shall prevent the common carrier providing the service to supply some other arrangement. The ODAPS contractor may provide low-level (RS-232) signaling between the ODAPS and Service A Weather as long as such arrangements are in agreement with tariff provisions. This approach may be desirable from an overall system viewpoint to allow easy conversion of low-speed telegraph I/O ports to medium-speed I/O ports at a later date.

400.3.1.2 CALLING OPERATION

Calling is used to initiate transmission of a message from the Service A Weather processor to one or more receiving stations on a circuit. The station on the circuit to receive the message shall be called by the two-character CDC assigned to that station, followed by on LTRS function. The called station shall automatically respond with a "V" when readied to receive. The relation of the station control unit to the condition of the station teletypewriter is depicted in the following:

STATE	STATION CONTROL UNIT	TELETYPEWRITER
1	Idle	Select Non-Print
2	Receives CDC (XX) - Generates "V" Answerback	Print
3	Receives SOA Code ( )	Non-Select
4	Receives EOM (H)	Select Non-Print

NOTE: State 1, and 4, are essentially the same.

400.3.1.3 SELECTION

CDC polling signals consist of two alpha characters followed by a letters shift. The complete CDC polling sequence includes a preceding letters shifts EOM signal, appearing as "Letters Shift NNNNAA Letters Shift". The preceding letters shift and EOM signals serve the same purpose as described in TSC polling. The succeeding letters shift is a timing impulse, included for slower electro-mechanical selector reaction. On receipt of its assigned CDC, a station selector shifts its associated Teletypewriter to print mode and maintains this state until and EOM signal is received. CDC polling occurs only when the Service A Weather computer has messages for transmission to a circuit. Message transmission will not commence until the "V" Answerback is received in the response to a CDC polled station 1. If several messages are queued for transmission, the Service A Weather computer will send multiple messages, each preceded with CDC polling, before TSC polling is resumed. For the case of multiple selections for the same messages the leading NNNN shall be used only for the first selection.

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APPENDIX 7

700.0 ODAPS - NORTH AMERICAN AEROSPACE DEFENSE COMMAND (NORAD) INTERFACE CONTROL DOCUMENT

700.1 INTRODUCTION

700.1.1 PURPOSE

The information herein describes the interface control requirements for communication between the North American Aerospace Defense Command (NORAD) Network and ODAPS/FDP. The intent is to provide for the design, implementation and interfacing of North American Aerospace Defense Command (NORAD) facilities with ODAPS/FDP.

700.1.2 REFERENCES

FAA/ATS PUB. 7610.4F, "Special Military Operations", Part II, Chapter 7, Section 2, Appendix 1 dated 1/21/82.

700.1.3 ORGANIZATION

FAA ARTCCS and North American Air Defense Command facilities currently interchange information pertaining to aircraft that penetrate defense identification 3 mls.

700.1.4 TECHNICAL SUMMARY

The North American Aerospace Defense Command (NORAD) network will use the ODAPS/FDP data base for aircraft flying oceanic and penetrating defense identification zones.

700.2 HARDWARE CHARACTERISTICS

700.2.1 EQUIPMENT REQUIRED

This document does not specify the detailed hardware interface to link the North American Aerospace Defense Command (NORAD) the ODAPS/FDP.

700.3 SOFTWARE REQUIRED

Information provided to NORAD facilities from the ODAPS/AMIS position shall include:

(1) ADDRESS/MESSAGE NUMBER (NORAD FACILITY)

(2) ACTIVATION SYMBOL

(3) FLIGHT/PLAN CATEGORY

(4) AIRCRAFT CALL SIGN

(5) ARTCC/AMIS IDENTIFICATION

(6) MESSAGE TYPE

(7) TYPE OF AIRCRAFT

(8) FLIGHT SIZE

(9) MAGNETIC HEADING

(10) ALTITUDE (HUNDREDS OF FEET)

(11) SPEED

(12) TIME OF ACTIVATION

(13) POINT OF ACTIVATION

(14) FIRST CHECK POINT

(15) SECOND CHECK POINT

(16) THIRD CHECK POINT

(17) FOURTH CHECK POINT

(18) DELAY POINT INDICATOR

(19) DELAY TIME

(20) MISSION ASSIGNMENT

(21) TRANSPONDER CODE (MODE 3A)

(22) INACTIVATION SYMBOL (EOM)

(23) REMARKS

700.3 SOFTWARE REQUIRED

Information provided to NORAD facilities from the ODAPS/AMIS position shall include:

(1) ADDRESS/MESSAGE NUMBER (NORAD FACILITY)

(2) ACTIVATION SYMBOL

(3) FLIGHT/PLAN CATEGORY

(4) AIRCRAFT CALL SIGN

(5) ARTCC/AMIS IDENTIFICATION

(6) MESSAGE TYPE

(7) TYPE OF AIRCRAFT

(8) FLIGHT SIZE

(9) MAGNETIC HEADING

(10) ALTITUDE (HUNDREDS OF FEET)

(11) SPEED

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(13) POINT OF ACTIVATION

(14) FIRST CHECK POINT

(15) SECOND CHECK POINT

(16) THIRD CHECK POINT

(17) FOURTH CHECK POINT

(18) DELAY POINT INDICATOR

(19) DELAY TIME

(20) MISSION ASSIGNMENT

(21) TRANSPONDER CODE (MODE 3A)

(22) INACTIVATION SYMBOL (EOM)

(23) REMARKS

Field No.	Field Name	Number of Characters	Range/ Legal Values	Description
1	Address and Message Number	no limit	alphanumeric	Values - alphanumeric
2	Activator Symbol	1	-	Begins the portion of the message carrying information for the computer program.
3	Flight Plan Category	1	F, B, S, Y	F = point to point flight which may or may not involve a planned delay in the correlation area B = SAC tactical flight S = NORAD special interest flight Y = SAC aircraft on EWO mission or a peace-time flight or movement of special interest as designated by the NORAD CP
4	Aircraft Call Sign	7	alphanumeric, &	Last letter or number will be followed by an (&) if there are less than seven characters
5	ARTCC/AMIS Source Designator	1	A - L	Character identifying the center transmitting the flight plan
6	Message Type	1	I, R, D, P	I = new flight plan R = revision to previous message D = drop or cancellation of a previously transmitted message P = progress report message
7	Type of Aircraft	4	alphanumeric, &, or ∅	Followed by (&) if fewer than four characters ∅ = the previous field is the last field in the message
8	Flight Size	2	01 - 31, &, or ∅	Number of aircraft (values greater than seven are displayed as seven) & = number of aircraft not available or not required ∅ = the previous field is the last field in the message
9	Magnetic Heading		&, or ∅	& = not required ∅ = the previous field is the last field in the message

Field No.	Field Name	Number of Characters	Range/Legal Values	Description
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Field No.	Field Name	Number of Characters	Range/ Legal Values	Description
17	Fourth Check Point	2 2 2 2	00 - 89 00 - 59 00 - 99 - 59, &, or #	Degrees north latitude Minutes of latitude Degrees of west longitude (See Note d) Minutes of longitude & = this information not required # = the previous field is the last field in the message
18	Delay Point Indicator	1	0 - 4, &, or #	0 = point of activation 1 = first check point 2 = second check point 3 = third check point 4 = fourth check point & = this information not required # = the previous field is the last field in the message
19	Delay Time	3	000 - 599, &, or #	Minutes & = this information not required # = the previous field is the last field in the message
20	SCATANA Priority	1 2	P 00 - 99, &, or #	& = SCATANA priorities are not in effect # = the previous field is the last field in the message
21	SIF Code	4	$0000-7777_8$ or #	Assigned mode 3 SIF code # = the previous field is the last field in the message
22	Inactivation Symbol	1	#	End the portion of the message carrying information for the computer program.
23	Remarks	no limit	alphanumeric	Not used by the computer program

Field No.	Field Name	Number of Characters	Range/ Legal Values	Description
17	Fourth Check Point	2 2 2 2	00 - 89 00 - 59 00 - 99 - 59, &, or #	Degrees north latitude Minutes of latitude Degrees of west longitude (See Note d) Minutes of longitude & = this information not required # = the previous field is the last field in the message
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			Message Symbol	1
			Activation Symbol	2
			Flt/Pln Category	3
			Aircraft Call Sign	4
			ARTCC/AMIS Ident.	5
			Message Type	6
			Type of AIRCRAFT	7
			Flight Size	8
			Heading	9
			Altitude	10
			Speed	11
			Time of Activation	12
			Point of Activation	13
			First Check Point	14
			Second Check Point	15
			Third Check Point	16
			Fourth Check Point	17
			Delay Point Indicator	18
			Delay Time	19
			Mission Assignment	20
			SIF Transponder Code	21
			Inactivation Symbol	22

			Message Symbol	1
			Activation Symbol	2
			Flt/Pln Category	3
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			ARTCC/AMIS Ident.	5
			Message Type	6
			Type of AIRCRAFT	7
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			Altitude	10
			Speed	11
			Time of Activation	12
			Point of Activation	13
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			Delay Time	19
			Mission Assignment	20
			SIF Transponder Code	21
			Inactivation Symbol	22

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Issue 1

NATS/TD/DP 228

Gander GAATS 21/ Shanwick OACC FDPS Interface Control Document

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Civil Aviation Authority London October 1981

NATS/TD/DP 228

Gander GAATS 2/ Shanwick OACC FDPS Interface Control Document

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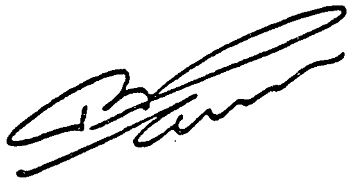
Civil Aviation Authority London October 1981

FOREWORD

GANDER GAATS 2/SHANWICK OACC FDPS INTERFACE CONTROL DOCUMENT

This document has **been** produced under the terms of the Memorandum of Understanding on **Programmes** *for* the Development of Oceanic Air Traffic Systems. between the **United** Kingdom Civil Aviation *Authority* and the Department of Transport, Canada. and constitutes an **agree**ment as **to the** methods, contents and procedures for communications between **Shanwick** *OACC* FDPS and Gander **GAATS** 2 automated **systems.*** Any changes to the requirements specified in this document **will** be subject to signed agreements **between** the two appropriate **delegated authorities.**

W G Codner
Directorate of Data Processing
(Air **Traffic Services)**
CAA



T Paine
Chief Systems and Equipment
Transport Canada

* **As signed** by the **Director ATS** of **Canada DOT** on 6 **May 1977 and the Director General (Tels) of** UK CAA **on 29 March 1977.**

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CONTENTS

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- storing appropriate weather information
- accepting some updating of stored flight data and providing:
- calculation of fix/times on oceanic tracks
- conflict detection in a fast time simulation mode
- printing of flight progress strips
- calculation of minimum time tracks between major cities in accordance with current weather forecasts
- performing a data transfer function with the existing flight data processing system at OACC Prestwick
- performing various statistics gathering tasks.

1.3.4 A replacement system, known during the transition phase as GAATS 2 will be put into operational use in the Spring of 1981.

2 GANDER/SHANWICK ON-LINE COMMUNICATIONS – GENERAL

2.1 Shanwick FDPS and GAATS 2 will be capable of operating both the existing and proposed communications protocols and message types so as to cope with GAATS 2 being introduced before the Apollo replacement, or vice versa.

2.2 On-line message transfer will initially be effected by discrete links, but may eventually be superseded by the AFTN subject to the latter satisfying the required standards as to integrity and response times.

2.3 The message types currently exchanged between Apollo and GAATS 1 on the discrete link are:

EST, PLM, RPT and TAM.

Examples of these messages are given in Part I, Appendix B. They are representative of the formats used at the time this document was produced, but these formats may be subject to changes due to operational requirements prior to the circumstances mentioned in para 2.1.

2.4 The following message types will be exchanged on the discrete link between Shanwick FDPS and GAATS 2. Details of format and examples are given in Part I, Appendix C:

CLR, CNL, MIS, RPT and TAM

NOTE: The NAT message will initially be exchanged between the systems via the AFTN in the format shown in Appendix C (Part I). It is intended to use the discrete link for the transmission of this message eventually.

2.5 All messages listed in para 2.4 except RPT and TAM will contain Data Transfer numbers consisting of a two-letter directional indicator followed by a three-numeric serial number.

The direction indicators will be 'GO' for Gander to Shanwick and 'OG' for Shanwick to Gander.

- storing flight plan information
- storing appropriate weather information
- accepting some updating of stored flight data and providing:
- calculation of fix/times on oceanic tracks
- conflict detection in a fast time simulation mode
- printing of flight progress strips
- calculation of minimum time tracks between major cities in accordance with current weather forecasts
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The direction indicators will be 'GO' for Gander to Shanwick and 'OG' for Shanwick to Gander.

capability to FL 60 or above at a later stage.) Data transfer for these flights will be in the form of CLR messages.

4.2 Transmission of the CLR message will be delayed by the originating unit as follows:

For eastbound flights transmission will be delayed until 20 minutes before the flight is estimated to reach 40°W.

For westbound flights transmission will be delayed until 20 minutes before the flight is estimated to reach 20°W.

The times stated will be adaptable to allow for changing operational requirements.

4.3 Each system will action the content of any 'CLR' message received, either by processing in accordance with local procedures, or by intimation of text failure to a local position.

4.4 For flights operating wholly on Organised Tracks the first position stated in the CLR will be 20°W or 40°W as dictated by the direction of flight, with the route being specified by the appropriate track designator (eg NATB). In the case of Random flights full route details from 20°W or 40°W will be transmitted. Both systems will be capable of transmitting the entire Oceanic route if this becomes an operational requirement.

4.5 When a flight (for which a CLR message has already been sent) is recleared, the CLR message containing the reclearance will be allocated a new Data Transfer number. It will not be necessary to send a CNL message in respect of the previous clearance.

4.6 A Data Transfer number (see para 2.5) will be allocated to ADT messages. The receiving system will issue a TAM when the Data Transfer number is received syntactically correct.

4.7 Each system will check for the continuity of Data Transfer numbers received, and output a notification locally in the event of discrepancies.

4.8 The originating computer will expect a TAM for each 'CLR' message issued. If no acknowledgement is received within three minutes the message will be re-issued. If, after a further 1% minutes a TAM has still not been received, the message will be issued for the third time. If after a further 1% minutes there is still no acknowledgement, a local message will be output for manual intervention.

5 REPEAT, CANCELLATION, AND MISCELLANEOUS MESSAGES

5.1 'RPT' messages will be sent by the receiving centre when missing serial numbers are detected, or when a message received containing a serial number is found to contain text errors. The RPT message will be input manually and actioned by the computer at the centre to which it is sent.

5.2 Each computer will be capable of actioning a RPT request for any or all of the 64 messages immediately preceding the latest message issued. The message repeated will be an exact copy of the message originally issued under the Data Transfer number quoted in the RPT.

5.3 A 'CNL' message will be generated when n-routing necessitates the cancellation of a previously sent 'CLR' message. This will occur when the flights' route will now no longer traverse airspace as defined in para 4.1. A 'TAM' will be expected.

5.4 The 'MIS message will be used to transmit plain language statements or queries between the two centres. In these cases the user will, after the message type field hyphen, be free of all format obligations. However, the MIS message will also be used for the transmission of NAT elapsed times which will be in the format specified in Part I, Appendix C

6 SYSTEM OR LINE FAILURES

6.1 System Failure

Basic communication facilities between the two centres will be available in the event of a system failure. The actions to be taken will be as defined in the current *version* of the Letter of Understanding for Special Co-ordination and Planning Procedures Between Shanwick OACC and Gander ACC.

will be an exact copy of the message originally issued under the Data Transfer number quoted in the RPT.

5.3 A 'CNL' message will be generated when n-routing necessitates the cancellation of a previously sent 'CLR' message. This will occur when the flights' route will now no longer traverse airspace as defined in para 4.1. A 'TAM' will be expected.

5.4 The 'MIS message will be used to transmit plain language statements or queries between the two centres. In these cases the user will, after the message type field hyphen, be free of all format obligations. However, the MIS message will also be used for the transmission of NAT elapsed times which will be in the format specified in Part II, Appendix C.

6 SYSTEM OR LINE FAILURES

6.1 System Failure

Basic communication facilities between the two centres will be available in the event of a system failure. The actions to be taken will be as defined in the current *version* of the Letter of Understanding for Special Co-ordination and Planning Proccdum Between Shanwick OACC and Gander ACC.

MESSAGE EXAMPLES (APOLLO/GAATS 1)

EST – Estimate Message

1 (ESTSG488–LH494–51N020W/1159F340M0840 NATF–DC10–EDDF–KJFK)

2 (ESTSG484–M50222–50N020W/0841F350M0750 49N030W/0947 48N040W/1056 46N050W/1209 SA/13 17–C141–EDAF–KDOV)

3 (ESTGS917–GK2–53N040W/1227F370M0820 NATE–DC10–KLAX–EGKK)

4 (ESTGS915–F1840–53N040W/1048F330M0820 53N030W/1129 53N020W/1210 53N015W/1231 SNN/1257–DC10–KBAL–ELLX)

PLM – Plain Language Message

(PLM–BA500 NO FPL FOR THIS A/C)

RPT – Repeat Message

(RPT–GS020)

TAM – Technical Acknowledgement Message

(TAM–GS121)

MESSAGE EXAMPLES (APOLLO/GAATS 1)

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PLM – Plain Language Message

(PLM–BA500 NO FPL FOR THIS A/C)

RPT – Repeat Message

(RPT–GS020)

TAM – Technical Acknowledgement Message

(TAM–GS121)

MIS - MISCELLANEOUS MESSAGE

Message Parameters: Eight-letter unit designator, plain language statements or forecast elapsed times table.

Message Format: ATS field 3, unit address, and free format field, or for ETAF tables as in the example, when the message will continue with the westbound times at the available flight levels, followed by the eastbound times for that track; then the remaining tracks in the same format, including SST track times.

The data elements required are:

(a) *Line 1* - Message heading and date time group of forecast;

(b) *Line 2* - Track heading line giving track identifier, flight level and direction of flight applicable;

(c) *Line 3* - Track route points;

(d) *Line 4* - Elapsed times between route points and cumulative total for speed of M080;

(e) *Lines 5 and 6* — As line 4 for M082 and M084. Lines 2 to 6 are repeated as necessary for each track and flight level.

(When initiated by Gander the eastbound-times will precede the westbound times for each track.)

Example: (MISOG999-CYQXZOCA-
RAF FORECAST TIME 181200 .
TRACK D FLIGHT LEVEL 310 WESTBOUND
YJT 52N50W 53N40W 53N30W 53N20W 53N15W SNN
M080 0057 0052 0050 0049 0025 0023 0416
MO82 0056 005 1 0049 0049 0024 0021 0409
M084 0055 0050 0048 0048 0023 0020 0403
etc.

NOTE: Gander will use EGGXZOCA and Shanwick will use CYQXZOCA to address MIS messages requiring the attention of the ATC Supervisor.

RPT - REPEAT MESSAGE

Message Parameters: Serial number of message to be repeated

Message Format: ATS fields 1, 4.

Example: (RPT-G0033)

TAM - TECHNICAL ACKNOWLEDGEMENT MESSAGE

Message Parameters: Message serial number

Message Format: ATS fields 1.4

Example: (TAM-G0100)

NAT – NORTH ATLANTIC TRACK MESSAGE

The Format Rules are as follows:

(a) fields are separated from each other by a single hyphen;

(b) the first element following the NATAA999 is the numeric group 1/1, 1/2, 2/2 to indicate the part number and number of parts in the message;

(c) the third field which may be repeated as necessary has the format for a Single Track Definition on a strict line for line basis.

Message Parameters:

Part number and number of parts (Numerics)
Upper and lower flight levels
Date and time range for the tracks
Part number and number of parts (Plain language)
Single track definitions:

- Track letter identifier
- Route points (lat/long, fishpoints, landfalls)
- Flight levels available
- Associated domestic airspace routes.

Message Format:

(NATAA999 – 9/9 TRACKS FLS 999/999 INCLUSIVE)
A (3–9) 99/9999Z to A (3-9) 99/9999Z
PART A (3-S) OF A (3-S) PARTS –
(Single track definition)*
END OF PART A (3-5) OF A (3-S) PARTS)

Single track definitions should be separated by hyphens

A X(3-l 1)* see note (i)
WEST LVLS 999* OR NIL — See note (v)
EAST LVLS 999" OR NIL — See note (v)
EUR RTS WEST 9 OR NIL — See note (vi)
EUR RTS EAST A (3–S) OR NIL — See note (vi)
NAR X (3–5)*

} Single track definition in track message

NOTES:

(i) Latitude/longitude is expressed in abbreviated form ie 2 or 4 numerics for latitude, oblique stroke, 2 or 4 numerics for longitude.

(ii) Fishpoints are expressed in full, up to five letters.

(ii) standard ICAO designators win be used for landfalls.

(iv) The Track message may be contained in one or more parts (due to AFTN message size limitations) individually transmitted.

(v) These lines will be interchanged when the message is originated by Gander.

(vi) These lines will not be included when the message is originated by Gander.

(vii) A free format field of up to 72 characters may be included after the final track definition in the message originated by Gander.

NAT – NORTH ATLANTIC TRACK MESSAGE

The Format Rules are as Follows:

(a) fields arc separated from each other by a single hyphen;

(b) the first element following the NATAA999 is the numeric group 1/1, 1/2, 2/2 to indicate the part number and number of parts in the message;

(c) the third field which may be repeated as necessary has the format for a Single Track Definition on a strict line for line basis.

Message Parameters: Part number and number of parts (Numerics)
Upper and lower flight levels
Date and time range for the tracks
Part number and number of parts (Plain language)
Single track definitions:

Track letter identifier
Route points (lat/long, fishpoints, landfills)
Flight levels available
Associated domestic airspace routes.

Message Format: (NATAA999 – 919 TRACKS FLS 999/999 INCLUSIVE)
A (3–9) 99/9999Z to A (3-9) 99/9999Z
PART A (3-S) OF A (3-S) PARTS –
(Single track definition)*
END OF PART A(3–5) OF A (3-S) PARTS)

Single track definitions should be separated by hyphens

AX(3-1 1)* see note (i)
WEST LVLS 999* OR NIL — See note (v)
EAST LVLS 999" OR NIL
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EUR RTS EAST A (3–S) OR NIL
NAR X (3–S)*

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(vii) A free format field of up to 72 characters may be induded after the final track definition in the message originated by Gander.

EXAMPLE OF TRACK MESSAGE FROM SHANWICK (Continued)

(NAT-2/2 TRACKS FLS 310/370 INCLUSIVE
MAY 25/1100Z TO 25/2200Z

PART TWO OF TWO PARTS -

F 52/15 52/20 52/30 52/40 51/50 YQX
WEST LVLS NIL
EAST LVLS 330 370
EUR RTS WEST NIL
EUR RTS EAST CRK
NAR NA13 NA14 NA67 NA68 -

G 50/08 50/20 50/30 50/40 49/50 YRZ
WEST LVLS NIL
EAST LVLS 330 370
EURRTSWESTNJL
EURRTSEASTLND
NAR NA7 NA8 NA9 NA63 NA64 -

H 43/13 43/20 43/30 42/40 42/50 42/60 POGGO
WEST LVLS 310 350
EAST LVLS NIL
EUR RTS WEST STG
EUR RTS EAST NIL
NAR NA100-

J 3930/15 40/20 40/30 40/40 40/50 40/60 POLLYACK
WEST LVLS 310 350
EAST LVLS NIL
EURRTSWESTNIL
EUR RTS EAST NIL
NAR -

END OF PART TWO OF TWO PARTS)

EXAMPLE OF TRACK MESSAGE FROM SHANWICK (Continued)

(NAT OG 121-22 TRACKS FLS 310/370 INCLUSIVE .
MAY 25/1100Z TO 25/2200Z

PART TWO OF TWO PARTS -

F 52/15 52/20 52/30 52/40 51/50 YQX
WEST LVLS NIL
EAST LVLS 330 370
EUR RTS WEST NIL
EUR RTS EAST CRK
NAR NA13 NA14 NA67 NA68 -

G 50/08 50/20 50/30 50/40 49/50 YRZ
WEST LVLS NIL
EAST LVLS 330 370
EUR RTS WEST NIL
EURRTSEASTLND
NAR NA7 NA8 NA9 NA63 NA64 -

H 43/13 43/20 43/30 42/40 42/50 42/60 POGGO
WEST LVLS 310 350
EAST LVLS NIL
EUR RTS WEST STG
EUR RTS EAST NIL
NAR NA100 -

J 39/15 40/20 40/30 40/40 40/50 40/60 POLLYACK
WEST LVLS 310 350
EASTLVLSNIL
EURRTSWESTNIL
EUR RTS EAST NIL
NAR -

END OF PART TWO OF TWO PARTS)

PART II COMMUNICATIONS PROTOCOLS AND CIRCUIT CHARACTERISTICS

1 INTRODUCTION

It has been agreed that in order to provide flexibility, GAATS 2 and OACC FDPS will need to be capable of operating in both the 'old' and the 'new' protocols. The 'old' protocol signifies GAATS 1/APOLLO messages in 5-level code at 75 baud, and the 'new' protocol refers to GAATS 2/OACC FDPS messages in 7-level code at 110 baud.

As stated in Part I, all GAATS 2/OACC FDPS messages may eventually be transferred via the AFTN. Appendix B shows the circuit routing between the two systems.

2 DESCRIPTION OF THE OLD PROTOCOL

2.1 GAATS 1/APOLLO Message Formats

2.1.1 *Direct Link Messages*

The following alignment and execute characters are used to encapsulate EST, TAM, RFT and PLM messages from APOLLO to GAATS 1:

⊟ << ≡ (message type and text – see Part I) << ≡ ≡ ≡ +

Messages from GAATS 1 to APOLLO are similar but the execute character (+) is replaced by '⊠' for APOLLO execute. The characters used have the following meaning:

⊟ Store buffer erase character (figures G 01001)
\+ Gander Computer execute (figures Z 10001)
⊠ APOLLO Computer execute (figures H 00101)
< Carriage Return
≡ Line Feed

2.1.2 *GAATS 1/APOLLO AFTN Messages*

Track information and elapsed time tables calculated by APOLLO for GAATS 1 are sent via AFTN. The elapsed time tables are transmitted in four blocks of up to • thousand characters each. Details of the AFTN format are given in Volume II of Annex 10 to the Convention on International Civil Aviation.

2.2 GAATS 1/APOLLO Message Code

The message code used with the 'old' protocol is CCITT No. 2 5 unit code. This consists of one start bit, 5 data bits and 1½ stop bits.

PART II COMMUNICATIONS PROTOCOLS AND CIRCUIT CHARACTERISTICS

1 INTRODUCTION

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The following alignment and execute characters are used to encapsulate EST, TAM, RPT and PLM messages from APOLLO to GAATS 1:

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Messages from GAATS 1 to APOLLO are similar but the execute character (+) is replaced by '☑' for APOLLO execute. The characters used have the following meaning:

- ≡ Store buffer erase character (figures G 01001)
- \+ Gander Computer execute (figures Z 10001)
- ☑ APOLLO Computer execute (figures H 00101)
- < Carriage Return
- • Line Feed

2.1.2 *GAATS 1/APOLLO AFTN Messages*

Track information and elapsed time tables calculated by APOLLO for GAATS 1 are sent via AFTN. The elapsed time tables are transmitted in four blocks of up to [illegible] thousand characters each. Details of the AFTN format are given in Volume II of Annex 10 to the Convention on International Civil Aviation.

2.2 GAATS 1/APOLLO Message Code

The message code used with the 'old' protocol is CCITT No.2 5-unit code. This consists of one start bit, 5 data bits and 1½ stop bits.

	50 Baud		200 Baud	
Channel	115	116	405	406
Mid Frequency (Hz)	2100	2220	2520	3000

3.3.3 The use of a channel at the top of the frequency spectrum may cause problems if the line quality drops. Therefore the top 200 baud channel at 3000 Hz mid-frequency will be used as the back-up.

4 COMMUNICATIONS FAILURES

4.1 APOLLO/GAATS 1

If APOLLO fails, message input/output is handled manually, a failure of the Prestwick to Gander direct line results in ADT activity being inhibited and messages being passed to Gander over the Speech lines. Messages can also be passed over AFTN.

If an AFTN Bearer circuit fails, the traffic can be handled by the alternative bearer circuit. (See also Part II, para 6.1.)

4.2 OACC FDPS/GAATS 2

In the event of a complete failure of the OACC FDPS, the input/output teleprinters will be connected directly to the and maintained manually.

If the duplex channel Prestwick to Gander fails, messages can be passed over the Speech lines manually. Messages can also be sent over the AFTN. (See also Part I, para 6.1.)

4.3 OACC FDPS Breaks in Messages

If breaks in ADT messages occur the system can tolerate pauses between incoming characters of up to 30 seconds. If a break does occur, then a Communications Control message is output to the Communications Management and Control Position.

7 Bit ISO/ASCII/CCITT Alphabet No. 5 for Telegraphy and Data Transmission *

Bits b_7	b_6	b_5											
							0	0	0	0	1	1	1	1
							0	0	1	1	0	0	1	1
							0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1	Row \ Col			0	1	2	3	4	5	6	7

b_4	b_3	b_2	b_1	Row	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	(TC_7)DLE	SP	0	@ (3)	P	` (3)	p
0	0	0	1	1	(TC_1)SOH	DC_1	!	1	A	Q	a	q
0	0	1	0	2	(TC_2)STX	DC_2	" (4)	2	B	R	b	r
0	0	1	1	3	(TC_3)ETX	DC_3	£ (2)(7)	3	C	S	c	s
0	1	0	0	4	(TC_4)EOT	DC_4	$ (2)(7)	4	D	T	d	t
0	1	0	1	5	(TC_5)ENQ	(TC_8)NAK	%	5	E	U	e	u
0	1	1	0	6	(TC_6)ACK	(TC_9)SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	(TC_{10})ETB	' (4)	7	G	W	g	w
1	0	0	0	8	FE_0(BS)	CAN	(	8	H	X	h	x
1	0	0	1	9	FE_1(HT)	EM	)	9	I	Y	i	y
1	0	1	0	10	FE_2(LF) (1)	SUB	*	: (8)	J	Z	j	z
1	0	1	1	11	FE_3(VT)	ESC	+	; (8)	K	[(3)	k	{ (3)
1	1	0	0	12	FE_4(FF)	IS_4(FS)	,	<	L	\ (3)	l		(3)
1	1	0	1	13	FE_5(CR) (1)	IS_3(GS)	–	=	M	] (3)	m	} (3)
1	1	1	0	14	SO	IS_2(RS)	.	>	N	^ (4)(6)	n	‾ (3)(5)
1	1	1	1	15	SI	IS_1(US)	/	?	O	_	o	DEL

*Compatible with ICAO 7-unit code.

NOTES

1. The controls CR and LF are intended for printer equipment which requires separate combinations to return the carriage and to feed a line.

For equipment which uses a single control for a combined carriage-return and line-feed operation, the function FE_2 will have the meaning of NEW LINE (NL).

These substitutions require agreement between sender and recipient. Use of the function NL is not permitted for international transmission on general switched telecommunication networks.

2. For international information interchange, £ and $ symbols do not designate the currency of a given country.

3. Reserved for national use. These positions are intended primarily for alphabetic extensions. If not required for that purpose, they may be used for symbols; in some cases a recommended choice is shown in parenthesis.

4. Positions 5/14, 6/0 and 7/14 are provided normally for the diacritical signs *circumflex accent, grave accent* and *overline*. However, these positions may be used for other graphical symbols when it is necessary to have 8, 9 or 10 positions for national use.

5. Position 7/14 is used for the *overline symbol*, which may be used to represent the *tilde* (~) or some other diacritical sign, provided that there is no risk of confusion with another symbol in the table.

6. The graphics in positions 2/2, 2/7 and 5/14 have respectively the significance of *quotation mark, apostrophe* and *upwards arrow*; however, these characters take on the significance of the diacritical signs *diaeresis, acute accent*, and *circumflex accent* when they precede or follow the *backspace* character.

7. For international information interchange, position 2/3 has the significance of the symbol £, and position 2/4, of the symbol $. By mutual agreement, where there is no requirement for the symbol £ the *number sign* symbol (#) may be used in position 2/3. Likewise, where there is no requirement for the symbol $ the *currency sign* symbol (¤) may be used in position 2/4.

8. If 10 and 11 as single characters are needed (e.g. for sterling currency) they should take the place of *colon* and *semicolon* respectively. These substitutions require agreement between sender and recipient. On the general telecommunications networks, the characters *colon* and *semicolon* are the only ones authorized for international transmission.

7 Bit ISO/ASCII/CCITT Alphabet No. 5 for Telegraphy and Data Transmission *

b_7					0	0	0	0	1	1	1	1
b_6					0	0	1	1	0	0	1	1
b_5					0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1	Row \ Col	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	(TC7)DLE	SP	0	@ 3	P	` 3	p
0	0	0	1	1	(TC1)SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	(TC2)STX	DC2	" 4	2	B	R	b	r
0	0	1	1	3	(TC3)ETX	DC3	£ # 7	3	C	S	c	s
0	1	0	0	4	(TC4)EOT	DC4	$ 7	4	D	T	d	t
0	1	0	1	5	(TC5)ENQ	(TC8)NAK	%	5	E	U	e	u
0	1	1	0	6	(TC6)ACK	(TC9)SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	(TC10)ETB	' 4	7	G	W	g	w
1	0	0	0	8	FE0(BS)	CAN	(	8	H	X	h	x
1	0	0	1	9	FE1(HT)	EM	)	9	I	Y	i	y
1	0	1	0	10	FE2(LF) 1	SUB	*	:	J	Z	j	z
1	0	1	1	11	FE3(VT)	ESC	+	;	K	[3	k	{
1	1	0	0	12	FE4(FF)	IS4(FS)	,	<	L	\ 3	l	|
1	1	0	1	13	FE5(CR) 1	IS3(GS)	—	=	M	] 3	m	}
1	1	1	0	14	SO	IS2(RS)	.	>	N	^ 3 4	n	‾ 3 5
1	1	1	1	15	SI	IS1(US)	/	?	O	—	o	DEL

*Compatible with ICAO 7-unit code.

NOTES

1. The controls CR and LF are intended for printer equipment which requires separate combinations to return the carriage and to feed a line.

For equipment which uses a single control for a combined carriage-return and line-feed operation, the function FE2 will have the meaning of NEW LINE (NL).

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6. The graphics in positions 2/2, 2/7 and 5/14 have respectively the significance of *quotation mark*, *apostrophe* and *upwards arrow*; however, these characters take on the significance of the diacritical signs *diaeresis*, *acute accent*, and *circumflex accent* when they precede or follow the *backspace* character.

7. For international information interchange, position 2/3 has the significance of the symbol £, and position 2/4, of the symbol $. By mutual agreement, where there is no requirement for the symbol £ the number sign symbol (#) may be used in position 2/3. Likewise, where there is no requirement for the symbol $ the currency sign symbol (¤) may be used in position 2/4.

8. If 10 and 11 as single characters are needed (e.g. for sterling currency) they should take the place of *colon* and *semicolon* respectively. These substitutions require agreement between sender and recipient. On the general telecommunications networks, the characters *colon* and *semicolon* are the only ones authorized for international transmission.

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3.2.6 Interface Buffer Adapter and Generator (IBAG)

3.2.6.1 General Description - The IBAG provides the interface between the Input/Output Processor (IOP) and the CDC units as shown in Figure 3.2.6.1-1. The IBAG processes all data, status, and command information transferred between the IOP and the Plan View Display (PVD) on output and the CDC switches, keyboard, and trackball on input. All circuitry common to more than one display will be redundant. In addition, the IBAG will have such controls and indicators necessary to operate the various functions for off-line checkout. It will be possible to manually enter data that will cause a presentation on an on-line PVD attached to the corresponding channel.

3.2.6.1.1 Electronic Design - All circuits will be designed such that no damage will occur when the equipment is operated with the operating controls and maintenance adjustments set to any possible configuration. No fuses will blow with actuation of any operational controls.

3.2.6.1.2 Spare Card Slots - Reserve circuit card capacity will be provided to accommodate at least 10% more cards in the display module.

3.2.6.1.3 Location of Controls - All controls will be on the front surface of the panel of the unit with which the control is associated or immediately behind front access panel doors of each unit to minimize the possibility of personnel coming in contact with high voltages and components operating at high temperatures. Controlled functions (such as gain and voltage) will increase with clockwise rotation as viewed from the operation position. There will be no noticeable lag between the actuation or adjustment of controls and the effect of the actuation or adjustment. All controls will have calibration markings to permit setting to pre-determined positions, except where it can be demonstrated to the satisfaction of the Government that such compliance is impracticable or unnecessary.

3.2.6.1.4 System Grounding - A common system grounding design criterion will be used for all units. The chassis will be isolated and will not be used as a conducting path. There will be no electrical connection between the cabinet and the individual modules except through the system ground cable. The design must be compatible with other equipment with which this system will interface.

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3.2.6.1.5 IBAG Drawers - The IBAG cabinet will contain an Input Output Drawer (IOD) and a maximum of 3 (three) Display Drawers (DD). An IOD will contain a maximum of 2 (two) Input Output Modules (IOM) and the DD shall contain a maximum of 2 (two) Display Modules (DM).

3.2.6.1.5.1 Input Output Module (IOM) - Each IOM will have the capability of operating 2 (two) identical channels to the IOP and a maximum of six DMs. Each IOM will be fabricated of sub-modules as shown in Figure 3.2.6.1-2 and defined as follows:

3.2.6.15 IBAG Drawers - The IBAG cabinet will contain an Input Output Drawer (IOD) and a maximum of 3 (three) Display Drawers (DD). An IOD will contain a maximum of 2 (two) Input Output Modules (IOM) and the DD shall contain a maximum of 2 (two) Display Modules (DM).

3.2.6.15.1 Input Output Module (IOM) - Each IOM will have the capability of operating 2 (two) identical channels to the IOP and a maximum of six DMs. Each IOM will be fabricated of submodules as shown in Figure 3.2.6-12 and defined as follows:

3.2.6.1.5.1.1 Display Buffer Control (DBC) - The DBC consists of a microprogrammed controller (MPC) and has 8 maximum of 4096 words of firmware for operational use and 8 maximum of 4096 words of firmware for diagnostic use. The DBC has overall control of the other sub-modules, taking data from the Channel Control (CC) and, if needed, manipulating the data and sending it to the Display Modules or the Console Input/Output (CIO).

3.2.6.1.5.1.2 Channel Control (CC) - The CC will consist of the necessary I/O circuits to interface with the IOP and the internal data bus. It shall also contain the necessary circuitry to interface the request and acknowledge signals required for operation with the IOP. All data shall be buffered between the data bus and the IOP.

3.2.6.1.5.1.3 Processor Input Control (PIC) - The PIC will be capable of accepting data from the Console Input Output (CIO) or the Refresh Buffer Memory (RBM) and transmitting it to the IOP in the proper format.

3.2.6.1.5.1.4 Console Input Output (CIO) - The CIO will accept data from the console switches, trackball and keyboard and transfer this data to the PIC upon command. It will generate any control signals necessary to drive the console. The CIO will contain the circuitry necessary to control some indicators on the PVD.

3.2.6.1.5.2 Display Module (DM) - Each DM shall contain the necessary buffering and control to generate a presentation on one PVD. It will also contain the logic necessary to interface the console switches and indicators. It will have a data path to each IOM. It will contain the following sub-modules as shown in Figure 3.2.6.1-3 and defined as follows:

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3.2.6.1.5.1.3 Processor Input Control (PIC) - The PIC will be capable of accepting data from the Console Input Output (CIO) or the Refresh Buffer Memory (RBM) and transmitting it to the IOP in the proper format.

3.2.6.1.5.1.4 Console Input Output (CIO) - The CIO will accept data from the console switches, trackball and keyboard and transfer this data to the PIC upon command. It will generate any control signals necessary to drive the console. The CIO will contain the circuitry necessary to control some indicators on the PVD.

3.2.6.1.5.2 Display Module (DM) - Each DM shall contain the necessary buffering and control to generate a presentation on one PVD. It will also contain the logic necessary to interface the console switches and indicators. It will have a data path to each IOM. It will contain the following sub-modules as shown in Figure 3.2.6.1-3 and defined as follows:

3.2.6.1.5.2.1 Refresh Buffer Memory (RBM) - The RBM will contain storage for a maximum of 8192 words of data, each containing 32 (thirty-two) (including 2 (two) parity) bits. It will be capable of refreshing the VGAC at a cycle time of 1.2 microseconds or less.

3.2.6.1.5.2.2 Vector Generator and Control (VGAC) - The VGAC will accept words from the RBM and generate the appropriate signals to cause a presentation on the PVD. The VGAC will also accept commands from the IOM for such control as required by EF words.

3.2.6.2 Detail Description -

3.2.6.2.1 Display Buffer Control (DBC) - The DBC is organized around a microprogrammed controller (MPC) and a source bus and destination bus. The various functional elements are gated onto the source bus and transferred through the Arithmetic Logic Unit (ALU) to be manipulated and stored, or gated to the Destination bus which transfers them to the various registers. For Block Diagram see Figure 326.2-1.

3.2.6.2.1.1 MPC Control - This section contains the firmware address registers (μP), μP Hold, Panel Select, the display reg., the breakpoint comparator, the condition reg., the cycle counters and other control logic.

3.2.6.2.1.2 ALU - The Arithmetic Logic Unit is used to manipulate data as it is transferred from source to destination. To do this the ALU contains shift regs., files, and a internal logic unit. It also contains some of the decode for the Instruction reg.

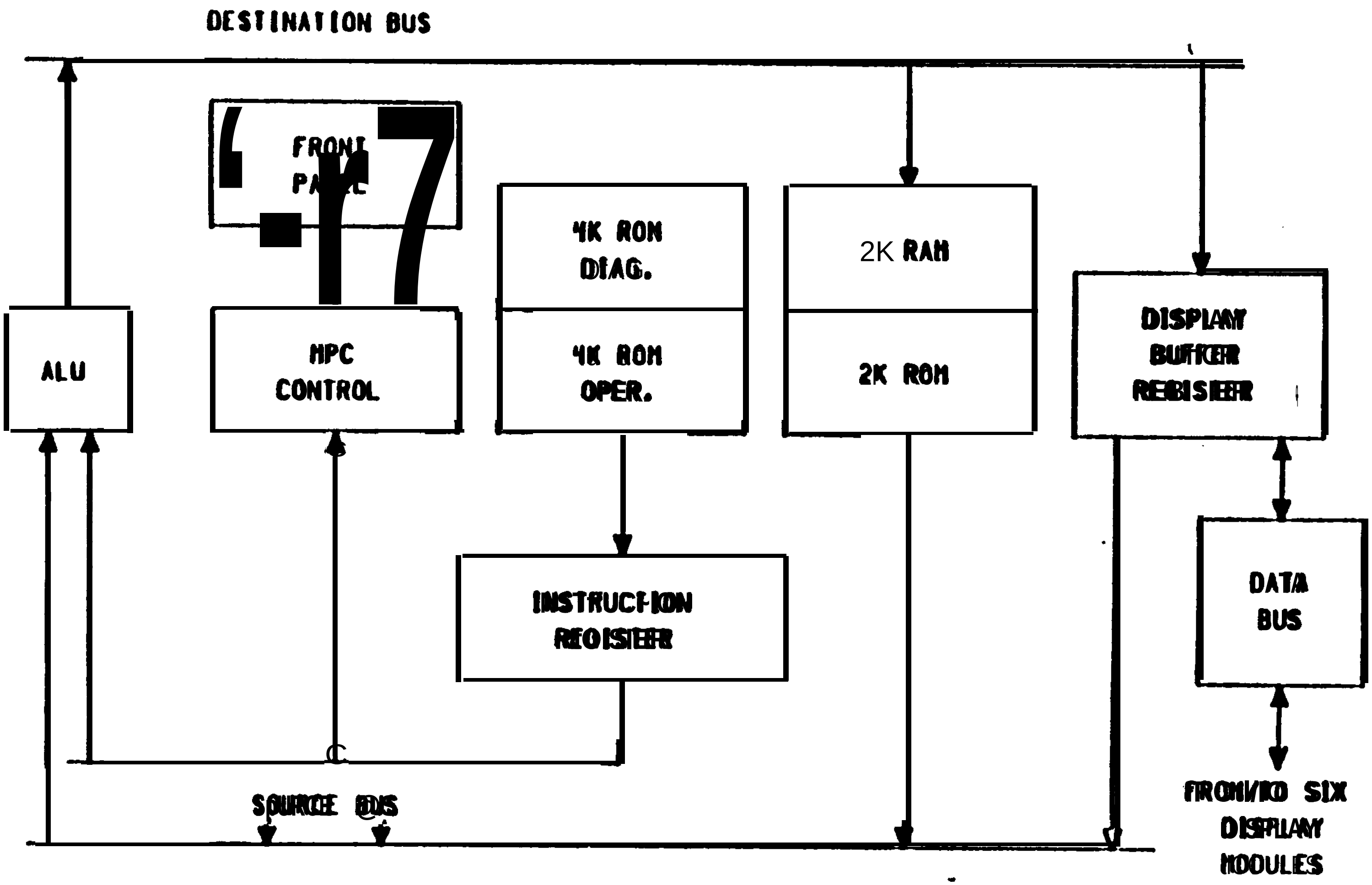

Figure 3.2.6.2-1. Display Buffer Control (DBC) Block Diagram

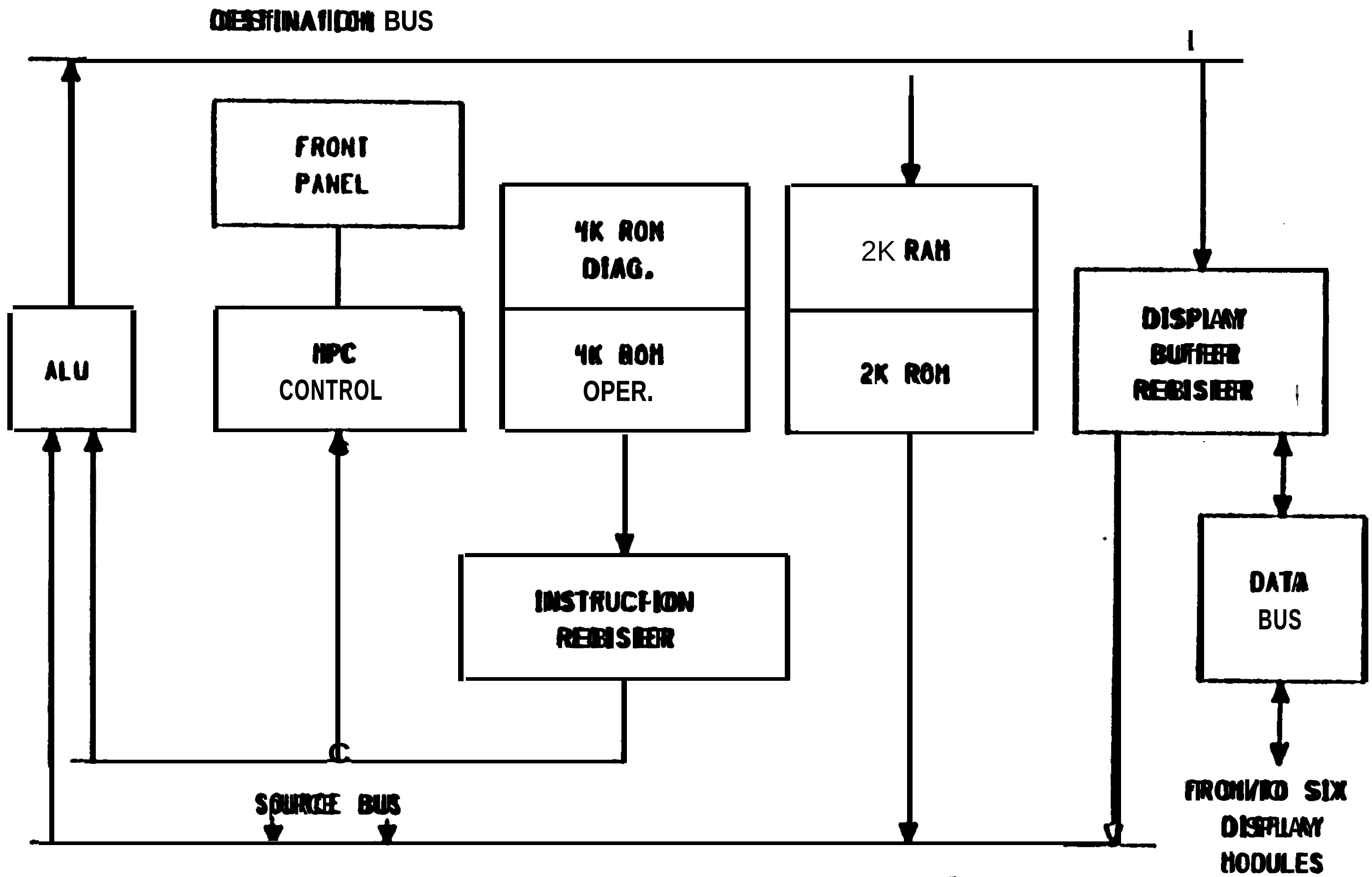

Figure 3.2.6.2-1. Display Buffer Control (DBC) Block Diagram

the IOP, will be done when the microprocessor references the lower of the IOP register as a source. Note: An EFA will cause both the EFR and the ODR to clear and both requests will reset at the same time.

f. The activation of the ODR to the IOP, subsequent to receiving an ODA from the IOP, will be done when the microprocessor references the lower of the IOP register as a source. Note: An ODA will cause both the ODR and the EFR to clear and both requests will reset at the same time.

g. A DM EIR or a DM IDR will be acknowledged by using the micro-control instruction (see paragraph A.3.14.10).

h. The IOM EIR will be cleared when the IOM status register is cleared, i.e. when the IOM status register is referenced as a source.

i. The Discrete 4 flag code will occur in the scan register if bit 4 of the Discrete register is set.

the IOP, will be done when the microprocessor references the lower of the IOP register as a source. Note: An EFA will cause both the EFR and the ODR to clear and both requests will reset at the same time.

f. The activation of the ODR to the IOP, subsequent to receiving an ODA from the IOP, will be done when the microprocessor references the lower of the IOP register as a source. Note: An ODA will cause both the ODR and the EFR to clear and both requests will reset at the same time.

g. A DM EIR or a DM IDR will be acknowledged by using the micro-control instruction (see paragraph A.3.14.10).

h. The IOM EIR will be cleared when the IOM status register is cleared, i.e. when the IOM status register is referenced as a source.

i. The Discrete 4 flag code will occur in the scan register if bit 4 of the Discrete register is set.

3.2.6.2.1.4 IOM Discrete Register - The purpose of this register is to provide information about selected requests as to their active or inactive state. The requests monitored are as follows:

a. Bit 2^0 indicates the status of the input data request (IDR) for the computer (IOP) in control. A zero state indicates the IDR is not active.

b. Bit 2^1 indicates the status of the external interrupt request (EIR) for the computer (IOP) in control. A zero state indicates the EIR is not active.

c. Bit 2^2 indicates the status of the selected DM's output data request ODR. A zero state indicates the request is not active. A one state indicates the DM is ready to receive an external function (EF) or output data (OD) word from the IOM. The selection of the DM is accomplished with bits 2^8, 2^9 and 2^{10}.

d. Bit 2^3 indicates the control status of the selected DM. A zero state indicates the IOM is not in control of the selected DM.

e. Bit 2^4 is used to generate the Discrete 4 flag code in the scan register. A zero state disables the flag code.

f. Bits 2^5 is a spare.

g. Bit 2^6 indicates which computer (IOP) is in control. A zero state indicates IOP channel A/C and a one state indicates IOP channel B/D.

h. Bit 2^7 indicates the status of the keyboard input. A zero state indicates that the keyboard input is not active. The DM selection in bits 2^8, 2^9 and 2^{10} does not apply to this input.

i. Bits 2^8, 2^9 and 2^{10} indicate which DM is to be interrogated. A number of 1 through 6 is valid.

j. Bits 2^0,2^1,2^2,2^3 and 2^7 are read only and may not be set by the microprogram. Bits 2^4,2^5,2^8 thru 2^{15} may be set or cleared by the microprogram. Bit 2^6 may be set or cleared by the microprogram only if the Chan Enable Switch is in the AB (or CD) position.

3.2.6.2.1.4 IOM Discrete Register - The purpose of this register is to provide information about selected requests as to their active or inactive state. The requests monitored are as follows:

a. Bit 2^0 indicates the status of the input data request (IDR) for the computer (IOP) in control. A zero state indicates the IDR is not active.

b. Bit 2^1 indicates the status of the external interrupt request (EIR) for the computer (IOP) in control. A zero state indicates the EIR is not active.

c. Bit 2^2 indicates the status of the selected DM's output data request ODR. A zero state indicates the request is not active. A one state indicates the DM is ready to receive an external function (EF) or output data (OD) word from the IOM. The selection of the DM is accomplished with bits 2^8, 2^9 and 2^{10}.

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h. Bit 2^7 indicates the status of the keyboard input. A zero state indicates that the keyboard input is not active. The DM selection in bits 2^8, 2^9 and 2^{10} does not apply to this input.

i. Bits 2^8, 2^9 and 2^{10} indicate which DM is to be interrogated. A number of 1 through 6 is valid.

j. Bits 2^0,2^1,2^2,2^3 and 2^7 are read only and may not be set by the microprogram. Bits 2^4,2^5,2^8 thru 2^{15} may be set or cleared by the microprogram. Bit 2^6 may be set or cleared by the microprogram only if the Chan Enable Switch is in the AB (or CD) position.

Characteristics of the Discrete Register -

a. When the IOM discrete register is referenced as a source by the microprocessor, all requests for the selected DM and IOP will be shown per Figure 3.2.6.2-3.

b. The DM number (1 through 6) and the control IOP will be stored into the discrete register by the microprocessor before referencing the register as a source.

c. The DM number does not apply to the keyboard input. Any keyboard input will cause the keyboard input request to be activated. The keyboard input will be provided from a RAM buffer and will come in groups of five words with one (1) request per word.

d. The requests monitored by the discrete register will be cleared as follows:

1. The IOP IDR will be cleared with the IOP input acknowledge.

2. The IOP EIR will be cleared with the IOP input acknowledge.

3. The DM ODR will be cleared following the transfer of the OD or EF word from the IOM to the DM. The DM CDR will be reset by the DM when it is ready to accept another word. A micro-control instruction will be used to initiate the transfer. The DM select code in the discrete register will be used to direct the OD or EF word to the correct DM.

4. The CM control bit will be set while the DM is under the control of the IOM. The DM select code in the discrete register will select the DM to be interrogated.

5. The keyboard IDR will clear and reset when the upper and lower halves of the CIO input register are referenced as a source.

   The resetting of the request will continue until the microprocessor has taken all five (5) words of input.

6. The CIO output register will not have an ODR, but will be used as a normal destination. The keyboard ID will be in the upper (bits 24-26) of the IOP word. Transferring into the lower of the CIO output register will indicate to the hardware that the register is loaded.

29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
			DM #											Word 4				Word 3				Word 2				Word 1			

CIO Output Word

3.2.6.2.1.5 4K OPER PROM - The operational program is stored in Programmed Read Only Memory chips. The memory is 16 data bits plus a parity bit wide and can have up to 4K addresses.

3.2.6.2.1.6 4K Diag PROM - The diagnostic program is stored in Programmed Read Only Memory chips. The memory is 16 data bits plus a parity bit wide and can have up to 4K addresses.

3.2.6.2.1.7 I Reg - The Instruction Register is 16 bits wide and will accept the instructions from the selected memory and hold them to be decoded by the MPC.

3.2.6.2.1.8 4K RAM - The Random Access Memory is 15 bits plus a parity bit wide and can have up to 2K addresses. The RAM has a Memory Address Register (MAR) that can be loaded by instruction and will be incremented by +1 with each read from or write into the RAM. There is a parity bit added to each write into memory and a parity check done on each read from memory. There is a bit set in status on a parity error. This section also has a 2K by 17 bit (16 data plus 1 parity) PROM to store constants for use by the MPC.

3.2.6.2.1.9 Display Buffer Register - This register is 32 bits wide and may be read or loaded by instruction. This register is used to drive the bus that interfaces with the six Display Modules. It can also be loaded with data from the Display Modules.

3.2.6.2.1.10 Panel - The panel will have switches and indicators to control operation of the DBC in Operation Mode (on line) and Diagnostic Mode. For detailed description of panel switches see paragraph 3.2.6.6.

29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
			DM #											Word 4				Word 3				Word 2				Word 1			

CIO Output Word

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3.2.6.2.1.9 Display Buffer Register - This register is 32 bits wide and may be read or loaded by instruction. This register is used to drive the bus that interfaces with the six Display Modules. It can also be loaded with data from the Display Modules.

3.2.6.2.1.10 Panel - The panel will have switches and indicators to control operation of the DBC in Operation mode (on line) and Diagnostic mode. For detailed description of panel switches see paragraph 3.2.6.6.

3.2.6.2.1 Channel Control - The CC section contains logic for interfacing with two IOP channels. Only one IOP will be operating with the IOM, the other will be locked out (except for it's IOP control EF).

Upon sensing an acknowledge from the IOP that specified a transfer of data from the IOP to the IBAG, the output word will be captured in a buffer register and the validity of the parity checked. The CC will then signal the DBC of the presence of the word for further processing. Figure 3.2.6.2-4 shows the block diagram of the CC.

Upon sensing a request from the PIC for transfer of data to the IOP, the CC will capture the data in a buffer register. If good parity is received, it will generate the appropriate request signal to the IOP.

3.2.6.2.2.1 Input Amplifier (IA) - There will be 32 IA's for data input and 4 IA's for acknowledges and enables per channel.

3.2.6.2.2.2 Line Driver (LD) - There will be 32 LD's for data and 4 LD's for requests per channel.

3.2.6.2.2.3 Input Data Register - This register (32 bits) will be a destination register to hold data on the lines until acknowledged by a IDA from the IOP. Proper parity is added to send to the LD's.

3.2.6.2.2.4 Output Data Register - This register (32 bits) holds Output or External Function data from the IOPs and checks for correct parity. In test mode it will accept data from the Input Data Registers.

3.2.6.2.2.5 Timing and Control - This section's main functions are:

a. Set IDR or EIR when input data is available

b. Setting and clearing appropriate bits in the IOM Scan and Discrete registers

c. Set ODR or EFR when the output Data Register is available

d. Time the dropping of request when acknowledge received

e. Control acknowledge and requests in test mode

3.2.6.2.3.1 CIO Output Register - This register receives data sent from the IOP to the control indicator lines on the RCRD.

3.2.6.2.3.2 Output RAM - This RAM has four addresses for each of six RCRD's. When a particular RCRD is selected and it has data to be sent the RAM will gate to the Parallel to Serial registers.

3.2.6.2.2 Channel Control - The CC section contains logic for interfacing with two IOP external channels. Only one IOP will be operating with the IOM, the other will be locked out (except for it's IOP control EF).

Upon sensing an acknowledge from the IOP that specified a transfer of data from the IOP to the IBAG, the output word will be captured in a buffer register and the validity of the parity checked. The CC will then signal the DBC of the presence of the word for further processing. Figure 3.2.6.2-4 shows the block diagram of the CC.

Upon sensing a request from the PIC for transfer of data to the IOP, the CC will capture the data in a buffer register. If good parity is received, it will generate the appropriate request signal to the IOP.

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3.2.6.2.2.4 Output Data Register - This register (32 bits) holds Output or External Function data from the IOPs and checks for correct parity. In test mode it will accept data from the Input Data Registers.

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a. Set IDR or EIR when input data is available

b. Setting and clearing appropriate bits in the IOM Scan and Discrete registers

c. Set ODR or EFR when the output Data Register is available

d. Time the dropping of request when acknowledge received

e. Control acknowledge and requests in test mode

3.2.6.2.3.1 CIO Output Register - This register receives data sent from the IOP to the control indicator lights on the RCRR

3.2.6.2.3.2 Output RAM - This RAM has four addresses for each of six RCRD's. When a particular RCRD is selected and it has data to be sent, the RAM will go to the Parallel to Serial registers.

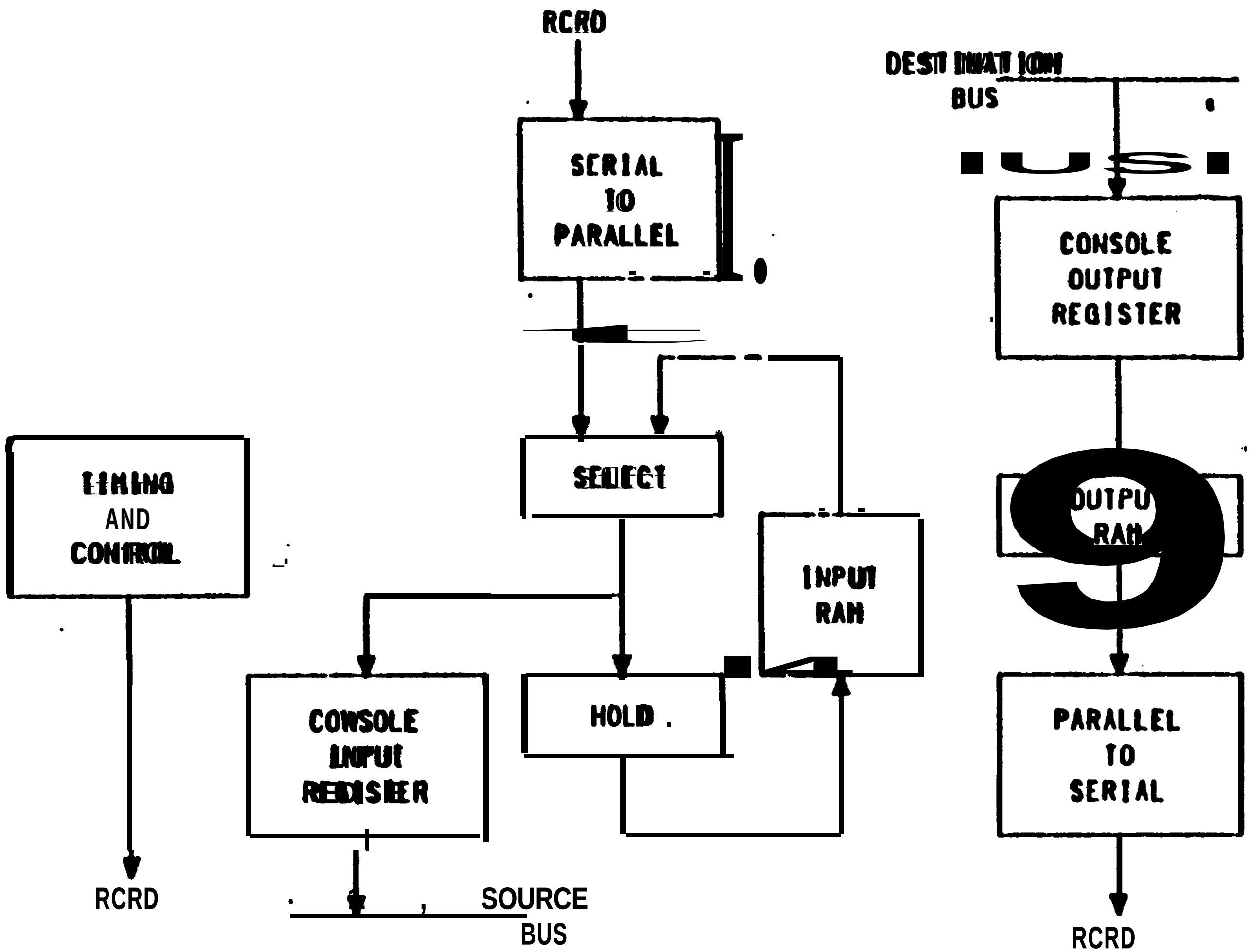

Figure 3.2.6.2-5. Console Input Output (CIO) Block Diagram

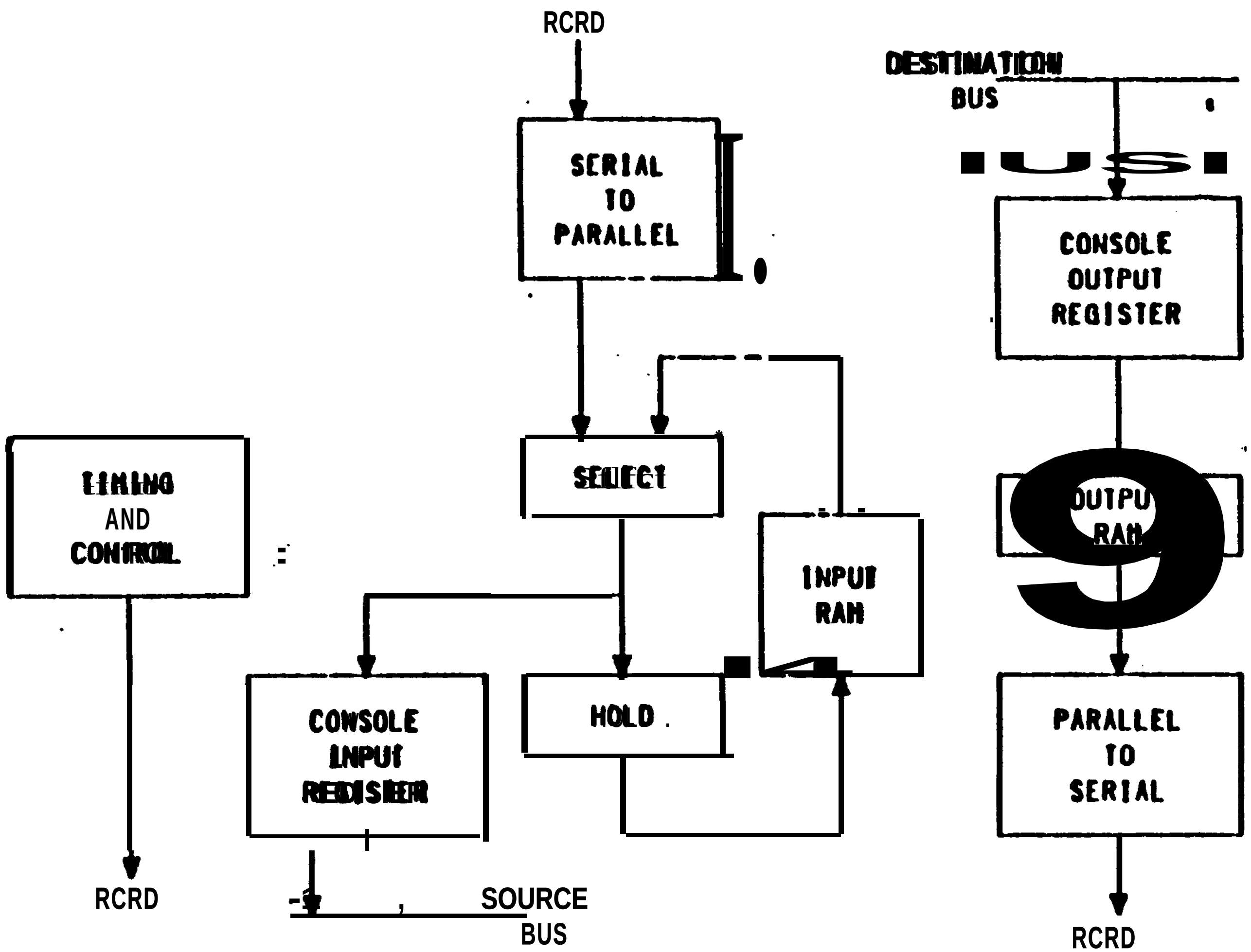

Figure 3.2.6.2-6, Console Input Output (CIO) Block Diagram

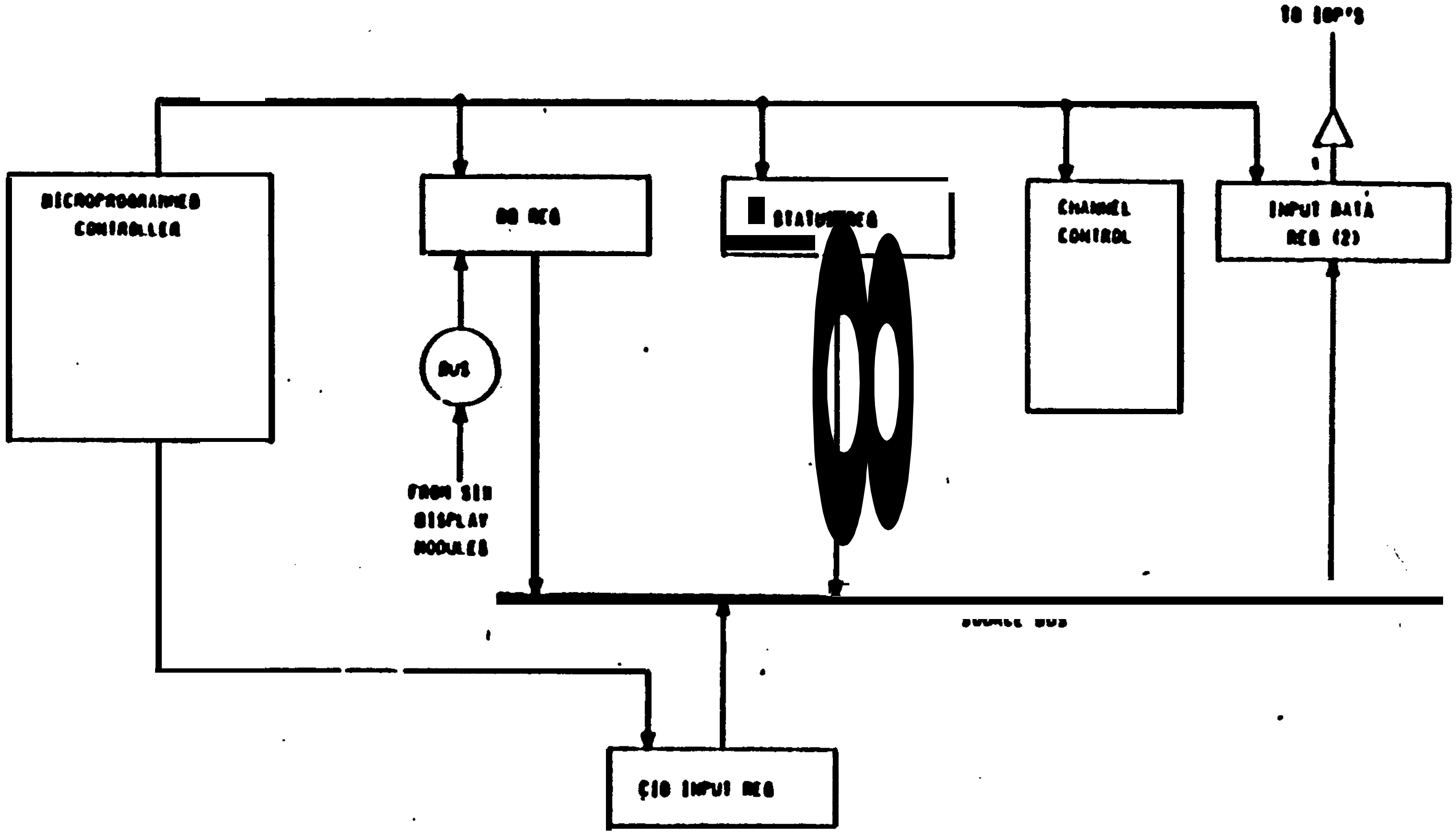

Figure 3.2.6.2-6. Processor Input Control (PIC) Block Diagram

8.3.4.7.2.5 Operation of IOM --. The operation of the IOM is dependent on the firmware instructions stored in PROM memory. The uP register addresses the PROM and a instruction is read from the register. This is decoded into F field for operation code, S designator to specify the source of the data to be used, D designator to specify the destination of the data and M designator to specify the modification of the data during transfer. There are also branch, control and repeat instructions. See Appendix A for Micro Instruction Repertoire Detail.

Normally the program is scaning the I/O scan register. When it gets a hit and determines the data must be scissored, offset or range scaled, it will go to a data processing routine. It then sends it to the proper DM.

The first thing received should be an IOP-Control EF that gives control of the DM's to the IOM. The IOP not in control can only send a IOP-control EF; the others will be discarded by the MPC.

A parity error on a EF will cause all the output data received (until the next EF) to be discarded; an EI will be sent. If the IOM receives an output data parity error, the data will be used; an EI will be sent.

The powered up state of requests shall be:

IOP channel A/C	EFR - Active
IOP channel A/C	ODR - Inactive
IOP channel A/C	IDR - Inactive
IOP channel A/C	EIR - Inactive
IOP channel B/D	EFR - Inactive
IOP channel B/D	ODR - Inactive
IOP channel B/D	IDR - Inactive
IOP channel B/D	EIR - Inactive
DM1	EFR - Active to IOM 81 only
DM1	ODR - Active to IOM 81 only
DM1	IDR - Inactive
DM1	EIR - Inactive

. Same for other 5 DM's

Keyboard	ODR	- Always ready as a destination (active)
Keyboard	IDR	- Inactive, but will go active approximately every 1.3 seconds if no change at keyboard when in the refresh mode.
Keyboard (IOM EIR)	EIR	- Inactive
IOU	EIR	- Inactive

3.2.6.2.5.1 Microprogram Input Output Processing - This section will describe the handling of the I/O activity that is under microprocessor control between the IOP, the IOM and the DM's.

The input-output processing between the IOP, the IOM and the display buffers (DM's) will be handled primarily through the use of the IOM scan register (see Figure 3.2.6.2-2) and the IOM discrete register (see Figure 3.2.6.2-3). The microprocessor executive will scan for the following types of requests and take the appropriate action when taking a hit. Types of requests scanned:

1. Display module external interrupt request (EIR). Upon detection of one of these requests from any of the six (6) displays being monitored, the microprocessor will cause the EIR data word to be transferred from the DM to the IOP, utilizing the repertoire of micro-instructions available. The possible causes of a DM EIR are as follows:

   a) DM memory parity error.

   b) IOM DM register transfer to DM ZP register parity error.

   c) 55 Hz error.

   d) DM not responding to IOM.

   e) Vector generator card error.

   f) Vector [illegible] test error.

2. IOP external functions (EF's). Upon detection of an EF, the microprocessor decodes the EF code and takes the following appropriate action:

   a) EF code of 0. Presently not intended to be used by the IOP (except to enter diagnostic mode) but will be used by the micro-diagnostics.

   b) EF code of 1. Send the EF word to the selected DM.

   c) EF code of 2. Store away the range for subsequent output from the

IOP. Set up to accept the output word for offset and the CIO output word.

d) EF code of 3. Send the EF word to the selected DM and set up to accept output from the IOP.

e) EF code of 4. Send the EF word to the selected DM.

f) EF code of 5. Send the EF word to the selected DM.

g) EF code of 6. Put the IOP in microprocessor control and assign DM's based on the lower six (6) bits of the EF word.

h) EF code of 7. Presently not used by the IOP (spare).

3. IOP output. Upon detection of an output from the IOP the microprocessor will take the following action.

a) Send output word to the selected DM if in the test data mode.

b) Send output word to the selected DM if in the display coordinate mode. (Except on an MT code of 4. Microprocessor will wait for P-words before sending the words to the DM)

c) Save output word if it is an offset output.

d) Send output word to the selected keyboard if it is a CIO output word.

e) Process output word based on the range and offset (see data processing section) and then send to the selected DM.

4. IOM external interrupt request (EIR). Detection of this request will cause the IOM status register to be transferred to the IOP in control via the EIR. The possible reasons for the generation of the IOM EIR are as follows.

a) Keyboard parity error (status reg bit 9)

b) IOM [illegible] parity error (status reg bit 2)

c) IOM [illegible] parity error (status reg bit 3)

d) CIM not unloaded error (status reg bit 8)

e) RBM IOM parity error (status reg bit 1)

5. Display module input data request (IDR). Upon detection of one of these requests from any of the six (6) displays being monitored the microprocessor will cause the readback data word to be transferred to the IOP via the

IOP input data request (IDR). The DM IDR's will only be generated if the DM had previously been put into the readback mode with a prior IOP EF.

6. IOP EF with a parity error. The microprocessor will not perform any processing on an EF with an associated parity error.

7. IOP output with a parity error. The microprocessor will process outputs with parity errors except when the previous EF also had a parity error.

The microprocessor executive will continue to scan through the use of the scan hardware after processing any of the above mentioned processing tasks. The executive will remain in a mode to accept EF's and output from the IOP while performing the processing of current EF's and outputs.

3.2.6.2.5.2 Data Processing - This section consists of two major divisions: Radar Coordinate to Display Coordinate Conversion and Vector Scissoring. The computation tasks are determined by decoding of the EF and F-Word commands from the IOP by the Input/Output Processing Section. Based on the low incidence of variation of the Range and Offset, some of the computational terms are pre-computed during decoding via the I/O Processing Section.

1. Display Coordinate Division. All radar to display coordinate conversions ultimately are routed through this area. If the conversion indicates an off-screen result, the no-process bit (NP bit 221, where [illegible]) is set in the associated F-word prior to transfer to the Display Buffer hardware. The following formulas are utilized:

$$X_d = \frac{((R - X_o) - X_p)\,512}{R}$$

$$Y_d = \frac{((R - Y_o) - Y_p)\,512}{R}$$

where

R = range or radius of display scope in NM.

Xo, Yo = scope X, Y offset in NM.

Xd, Yd = resultant display coordinates.

Xp, Yp = radar point coordinates

2. Vector Scissoring. All vectors in radar coordinates are processed by this portion to determine:

a) If complete vector is off-screen, treat as no-process and transfer

IOP input data request (IDR). The DM IDR's will only be generated if the DM had previously been put into the readback mode with a prior IOP EF.

6. IOP EF with a parity error. The microprocessor will not perform any processing on an EF with an associated parity error.

7. IOP output with a parity error. The microprocessor will process outputs with parity errors except when the previous EF also had a parity error.

The microprocessor executive will continue to scan through the use of the scan hardware after processing any of the above mentioned processing tasks. The executive will remain in a mode to accept EF's and output from the IOP while performing the processing of current EF's and outputs.

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1. Display Coordinate Division. All radar to display coordinate conversions ultimately are routed through this area. If the conversion indicates an off-screen result, the no-process bit (NP bit 22), where applicable, is set in the associated F-word prior to transfer to the Display Buffer hardware. The following formulas are utilized:

$$X_d = \frac{((R-X_o) + X_p)\,512}{R}$$

$$Y_d = \frac{((R-Y_o) - Y_p)\,512}{R}$$

where

R = range or radius of display scope in NM.

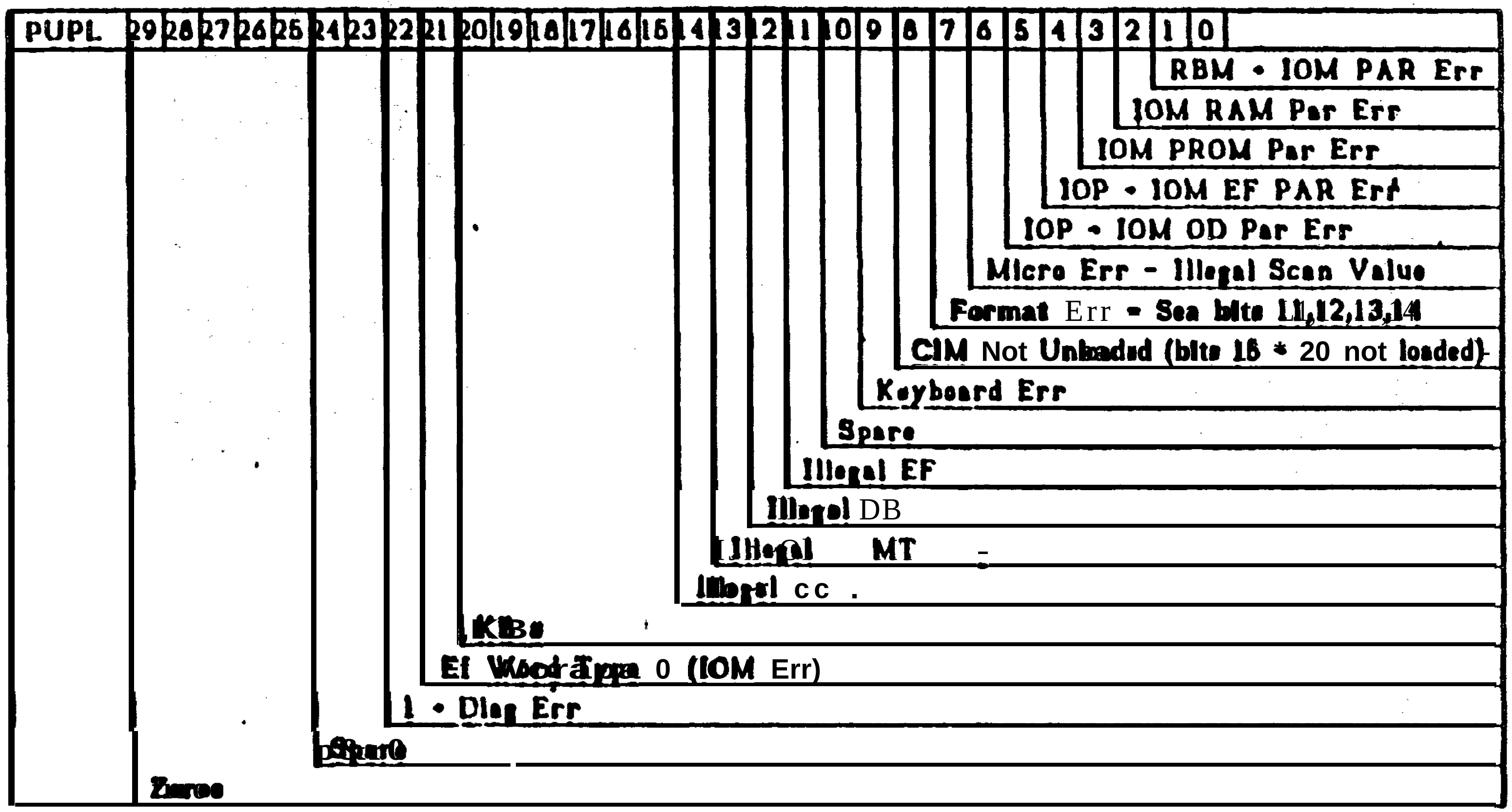
X_o, Y_o = scope X, Y offset in NM.

X_d, Y_d = resultant display coordinates.

X_p, Y_p = radar point coordinate

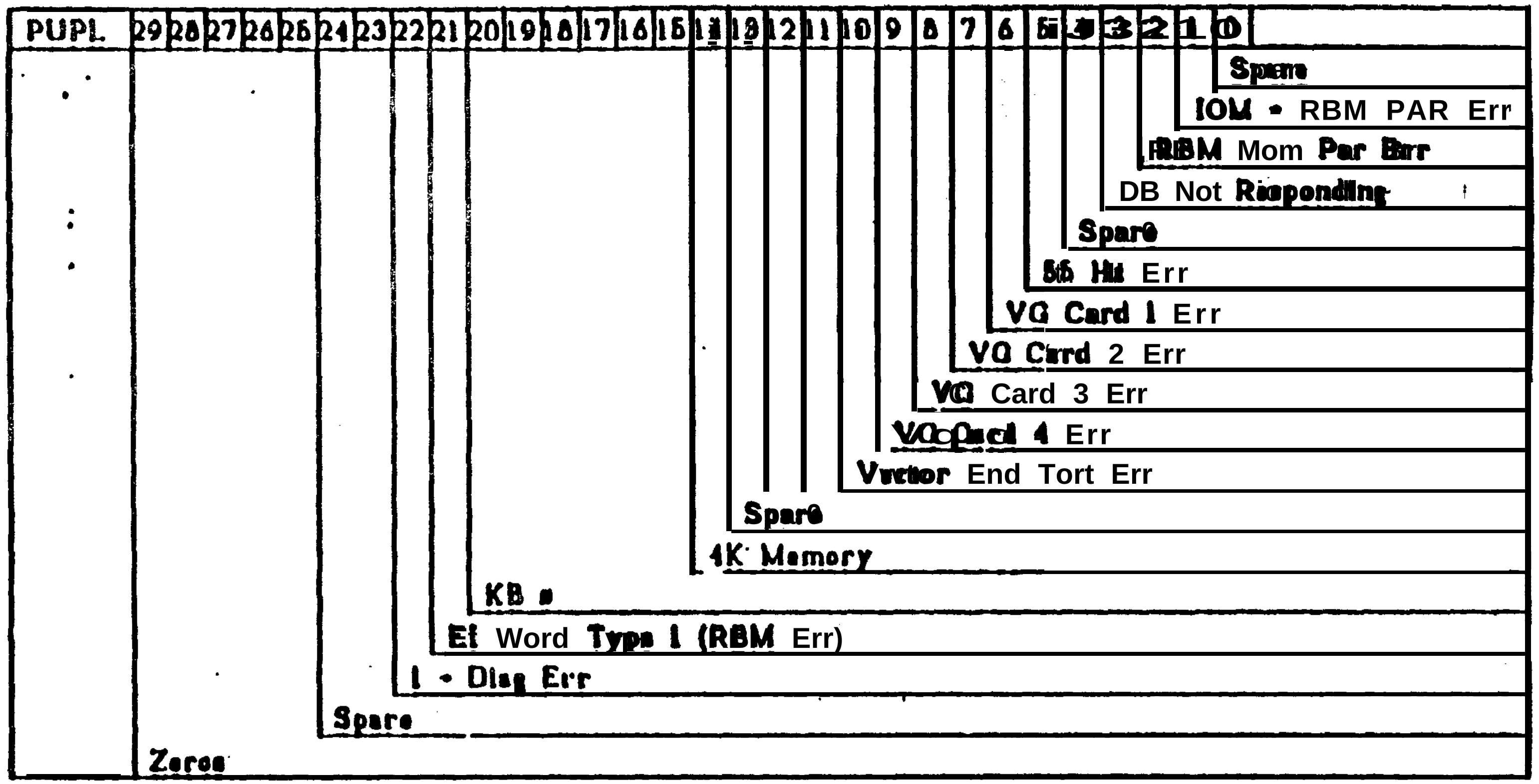
2. Vector Scissoring. All vectors in radar coordinates are processed by this portion to determine:

a) If complete vector is off-screen, treat as no-process and transfer



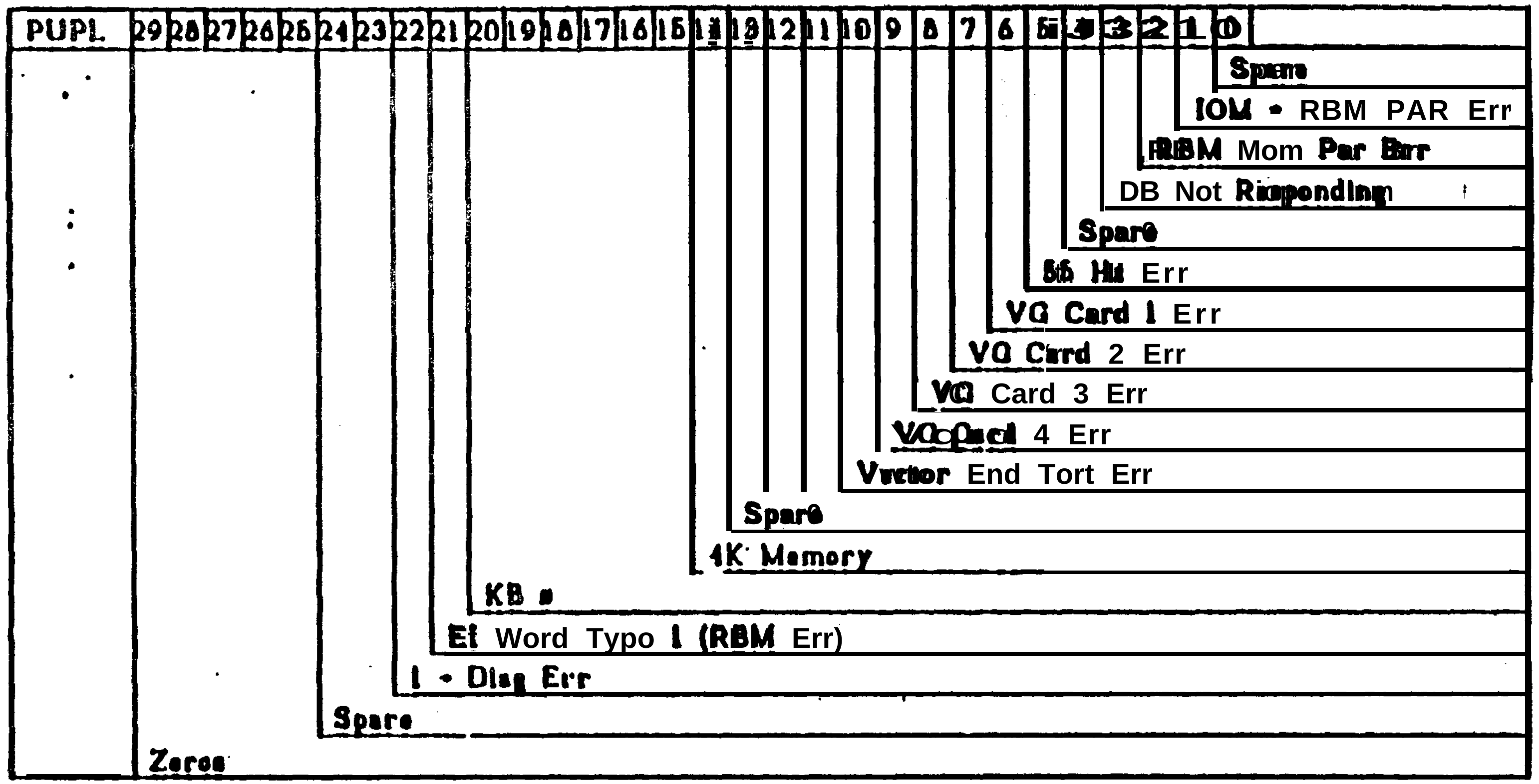
EF Status Word sent to IOP

Figure 3.2.6.2-7. External Interrupt Format IOM Error (page 1 of 2)



EI Status Word Sent to IOP

Figure 3.2.6.2-7, External Interrupt Format - RBM Error (page 2 of 2)



El Status Word Sent to IOP

Figure 3.2.6.2-7, External Interrupt Format - RBM Error (page 2 of 2)

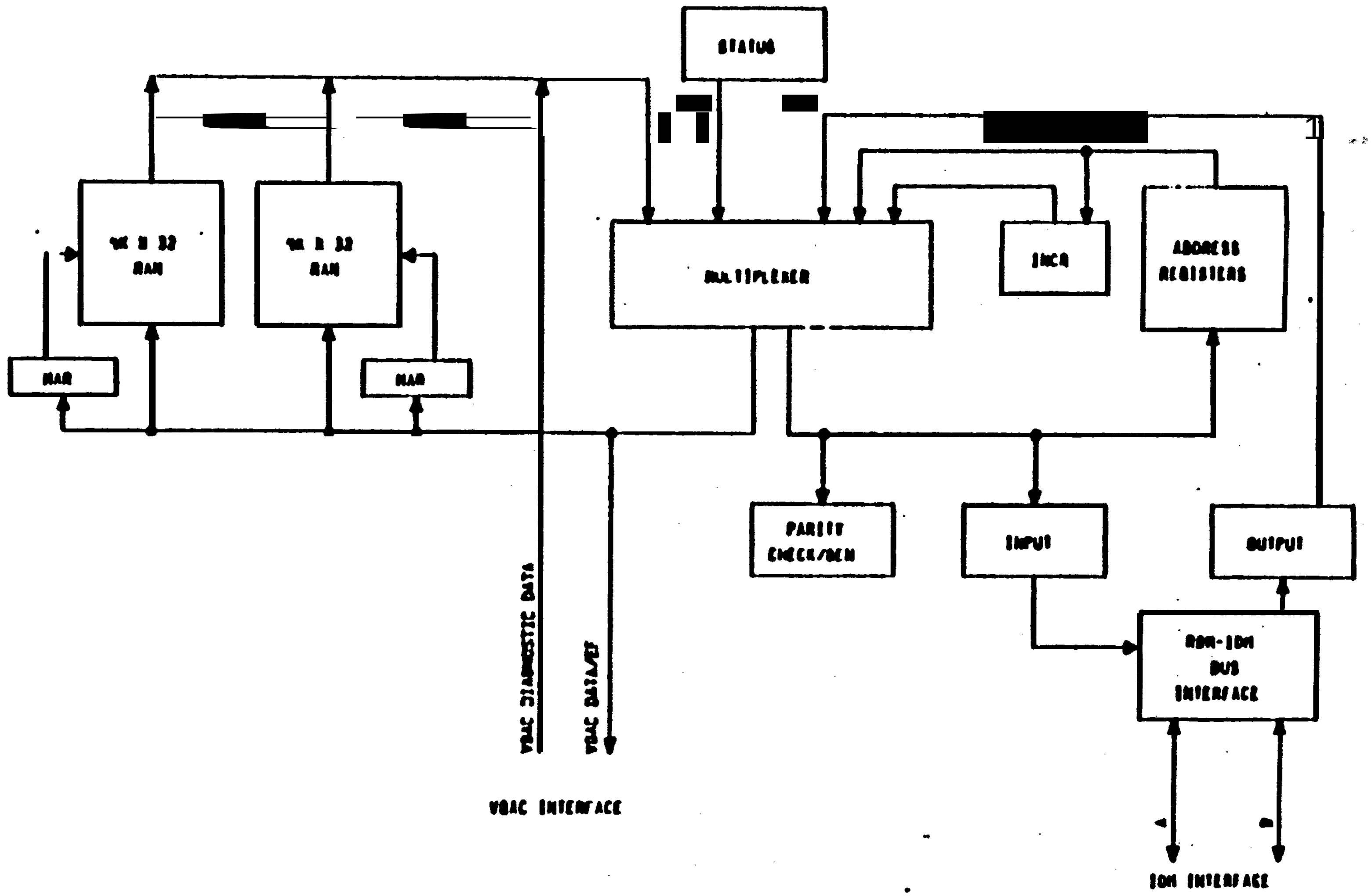


Figure 3.2.6.2-8. RBM Block Diagram

3.2.6.2.6.4 Dual IOM Interface - The IOM interface includes a 32-bit output register for EF's and data from the IOM, a 32-bit input register for EI's and data to the IOM and a dual bus interface with logic for establishing control by one IOM at a time.

3.2.6.2.6.5 VGAC Interface - The VGAC interface includes a 32-bit bus for EF's and data to the VGAC, a 30-bit bus for diagnostic data from the VGAC and other status and control signals.

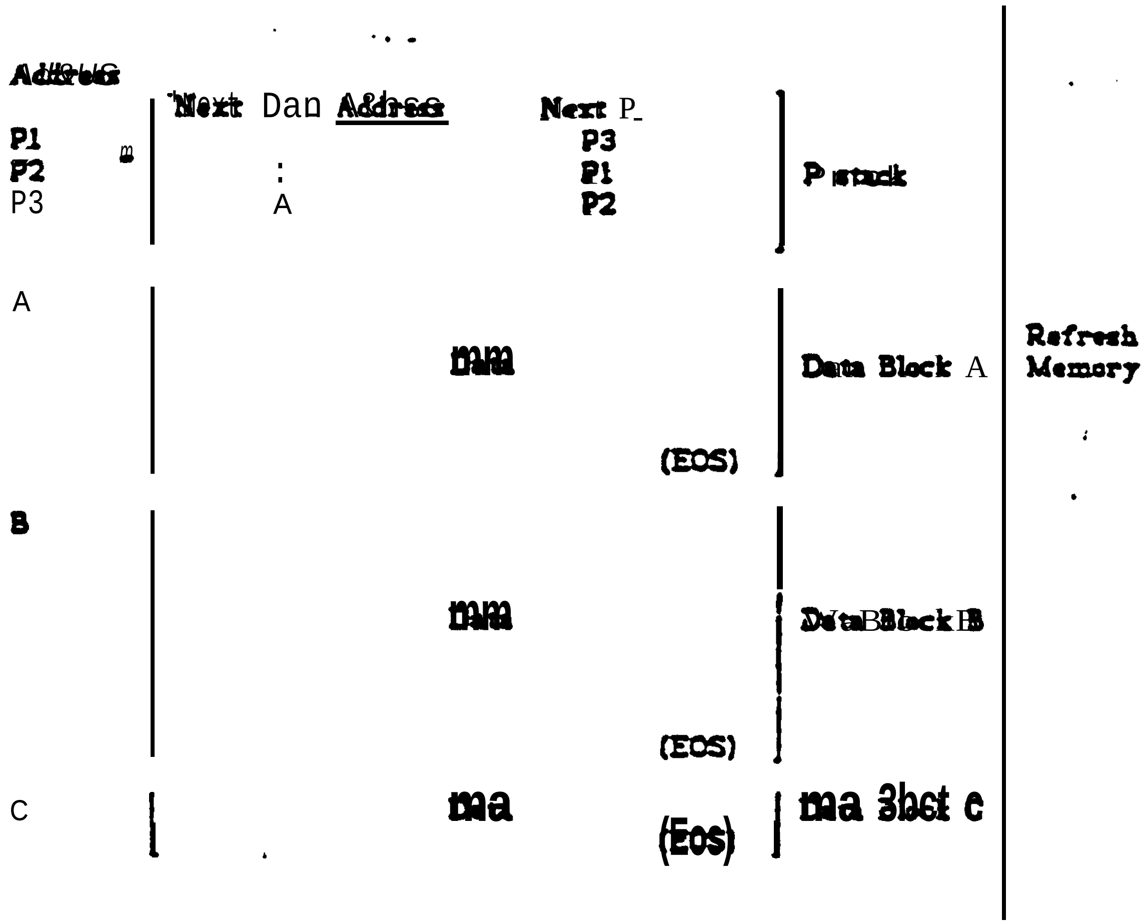
3.2.6.2.6.6 Status Register - The status register captures and holds [illegible] information for transmission to the IOM. The status register includes bits for IOM interface parity error, memory parity error and bits for VGAC [illegible].

3.2.6.2.6.7 Operational Description -

3.2.6.2.6.7.1 Refresh Mode - The RBM stores distinct data blocks linked by 8 buffer [illegible] address file (P stack).

Each data block consists of one P stack word, a variable number of data words and an end of sublist redundant F word (EOS). the data words must be stored in sequential memory addresses. The EOS word is the last data word. The P stack word may be anywhere in memory. The P stack word contains the starting address of the data block and the address of the next P stack word. After the RBM detects and transfers the EOS word, it reads the next P stack word and begins transferring the next data block. The last P stack word must reference the first P stack word to provide a continuous circular data buffer.

The RBM maintains current refresh data address (SD register) and transfers data to the VGAC on request. The RBM also saves the next P stack address (P register) for use when the EOS word is detected indicating end of a data block. Refresh mode is controlled by EF from the IOM. The set refresh EF (EF-5 with bit 23 clear) causes refresh to begin at the P stack word specified in the lower 13 bits of the EF word. The initial P stack word will specify the starting data word address and the next P stack word. the clear refresh EF (EF-5 with bit 23 set) will terminate refresh mode.

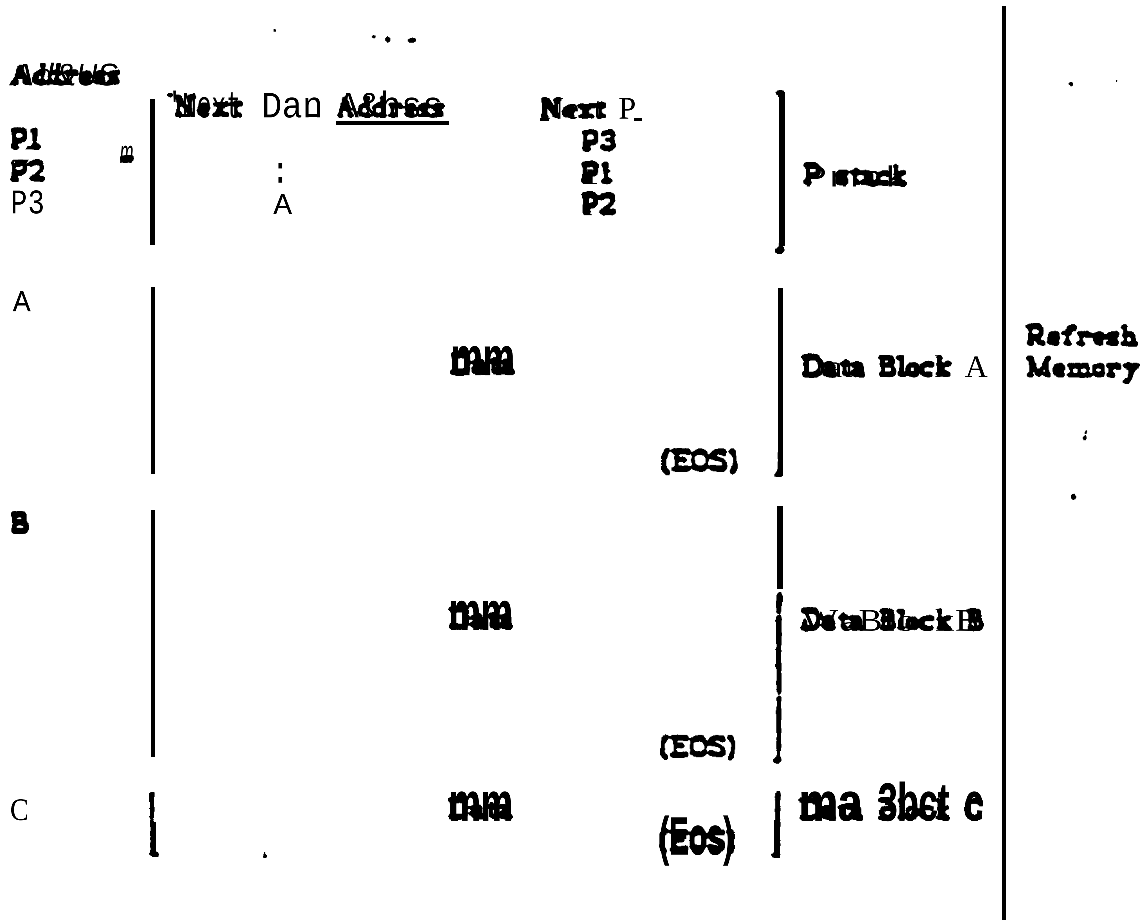


Order of refresh: Data Block B, Data Block A, Data Block C

Example: Refresh Memory Organization

3.2.6.2.6.7.2 Update Mode - The IOM May load refresh data and P stack words into RBM using the update mode of operation. Each output data word transferred to the RBM will be stored in memory at the address held in the RBM SPS register. The SPS register is incremented after each data word is received and stored. The SPS register may be initialized and modified by EF command from the IOM. The Set Update Address EF (EF-3) loads a new 13 bit address into the SPS register.

3.2.6.2.6.7.3 Readback Mode - Readback mode provides a means of transfering memory data back to the IOM for verification. Readback mode is initiated by EF from the IOM. The Set Readback EF (EF-4 with bit 23 clear) shall cause readback to begin at the address specified in the lower 13 bits of the EF word. The RBM shall save this address in the SPF register. The RBM shall set the Input Data Request (IDR) to the IOM for each word to be transferred. The SPF register shall be incremented after each word is read and transferred. Readback will continue until cleared by



Order of refresh: Data Block B, Data Block A, Data Block C

Example: Refresh Memory Organization

3.2.6.2.6.7.2 Update Mode - The IOM May load refresh data and P stack words into RBM using the update mode of operation. Each output data word transferred to the RBM will be stored in memory at the address held in the RBM SPS register. The SPS register is incremented after each data word is received and stored. The SPS register may be initialized and modified by EF command from the IOM. The Set Update Address EF (EF-3) loads a new 13 bit address into the SPS register.

3.2.6.2.6.7.3 Readback Mode - Readback mode provides a means of transfering memory data back to the IOM for verification. Readback mode is initiated by EF from the IOM. The Set Readback EF (EF-4 with bit 23 clear) shall cause readback to begin at the address specified in the lower 13 bits of the EF word. The RBM shall save this address in the SPF register. The RBM shall set the Input Data Request (IDR) to the IOM for each word to be transferred. The SPF register shall be incremented after each word is read and transferred. Readback will continue until cleared by

EF-3 Set Update Address - Transfer bits 0 through 12 to SPS register.

EF-4 Set/Clr Readback - Transfer bits 0 through 12 to SPF register.

bit 23 - If 0 initiate readback mode, if 1 terminate readback mode.

EF-5 Set/Clr Refresh - Transfer bits 0 through 12 to P register.

bit 23 - If 0 initiate refresh using new value of P register, if 1 terminate refresh.

EF-6 IOM Control -

bit 0 - If 1 (demand control) switch control to IOM that sent the EF and master clear the RBM. If 0 (release control) switch control to the IOM that did not send the EF and master clear the RBM. This EF may be overridden by front panel control switch.

EF-7 Not Used.

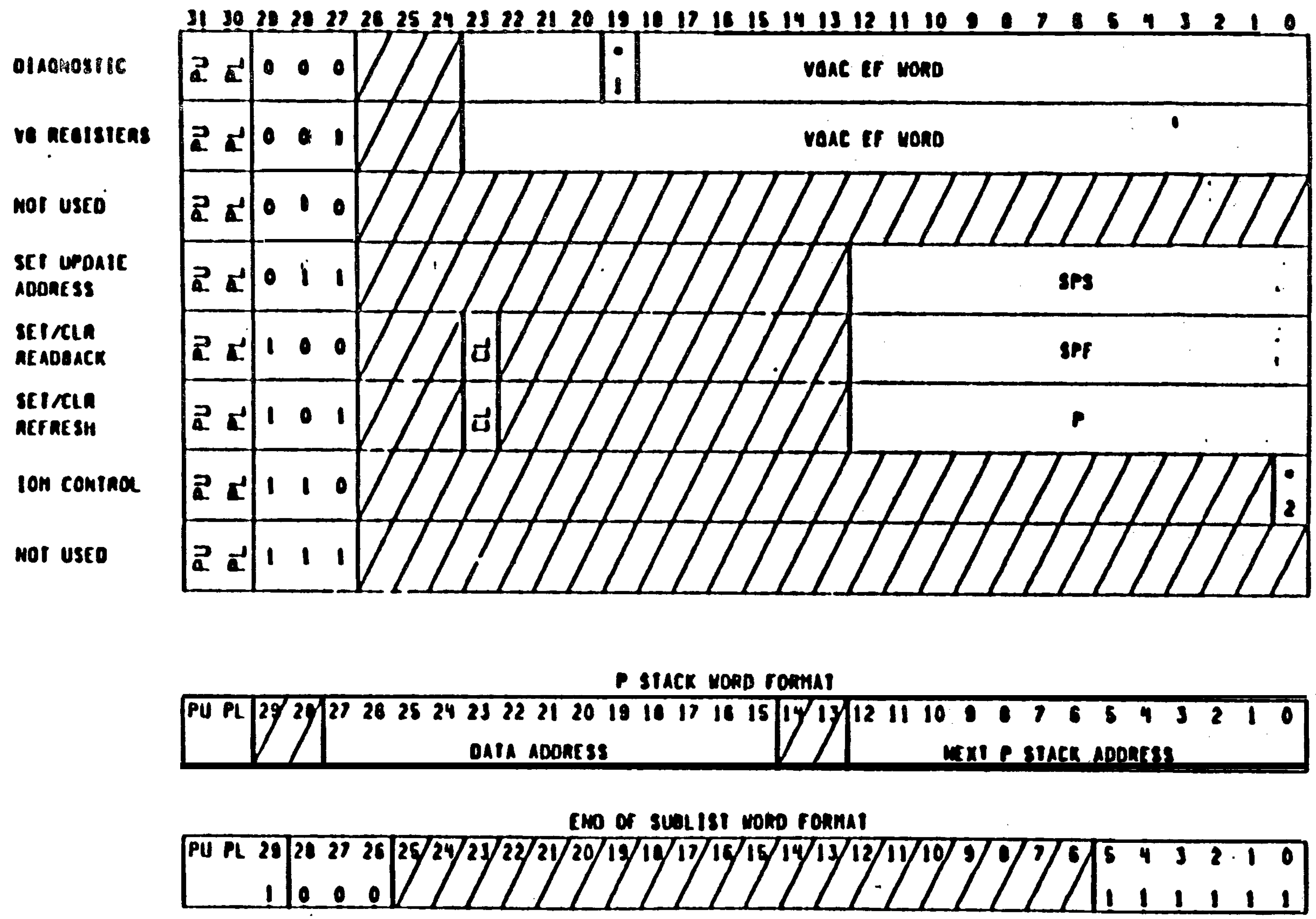


Figure 3.2.6.2-9. RBM EF Formats

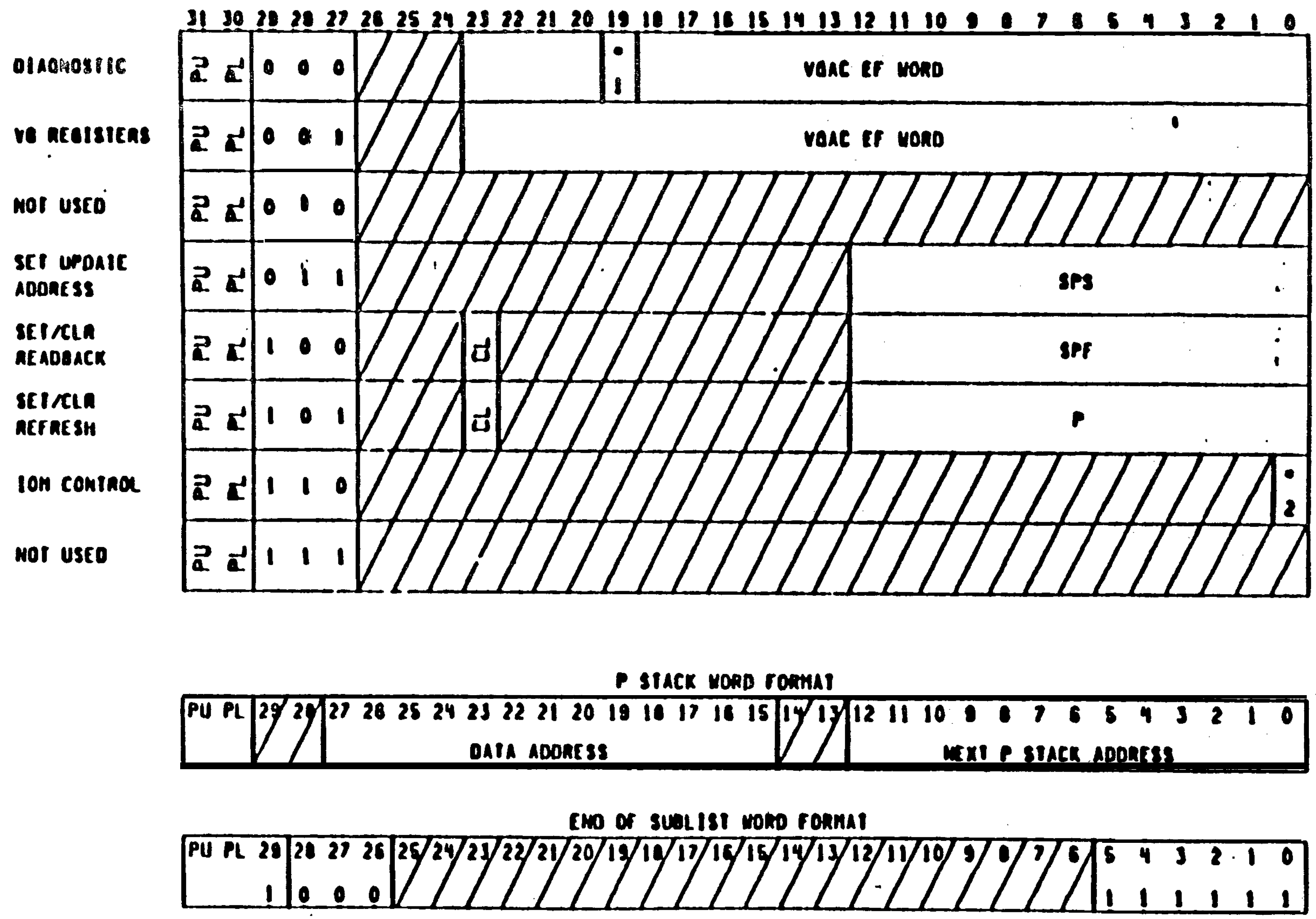
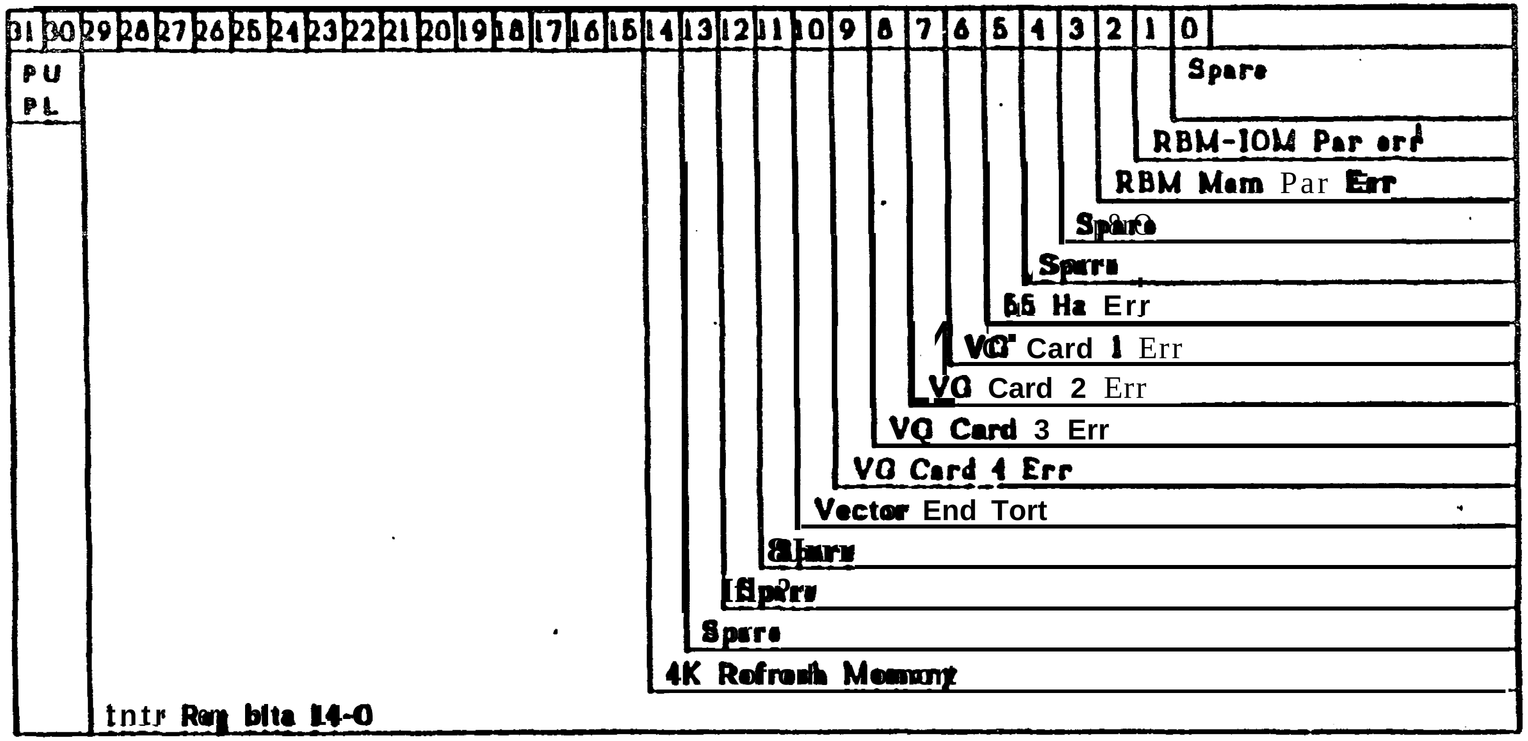


Figure 3.2.6.2-9. RBM EF Formats



Et Status word Sent to IOM

Figure 3.2.6.2-10. RBM Status Word Format

3.2.6.2.7 Vector Generator and control (VGAC) - The VGAC is made up of four basic sections. The RBM interface, the processing section, the output section, and the diagnostic section. See the block diagram on Figure 3.2.6.2-11 and 3.2.6.2-12.

3.2.6.2.7 Vector Generator and control (VGAC) - The VGAC is made up of four basic sections. The RBM interface, the processing section, the output section, and the diagnostic section. See the block diagram on Figure 3.2.6.2-11 and 3.2.6.2-12.

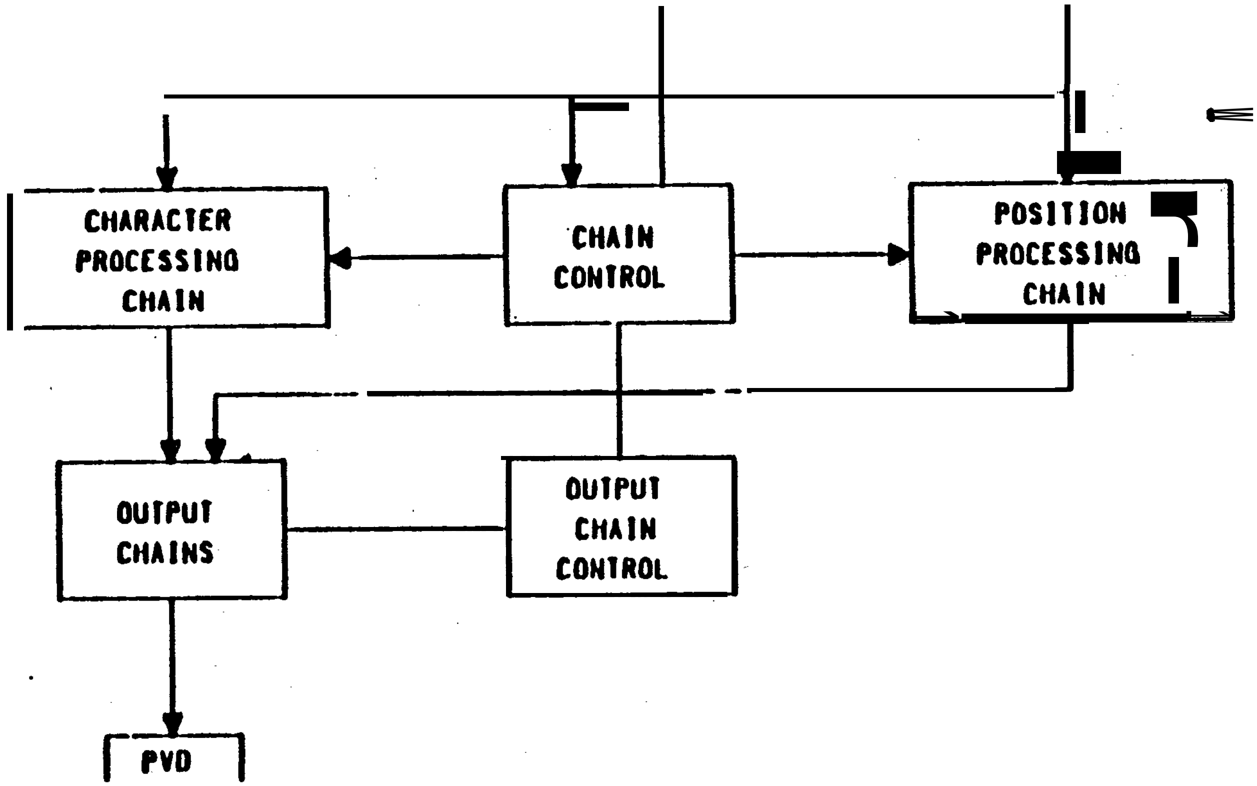


Figure 3.2.6.2-12. VGAC Processing Section

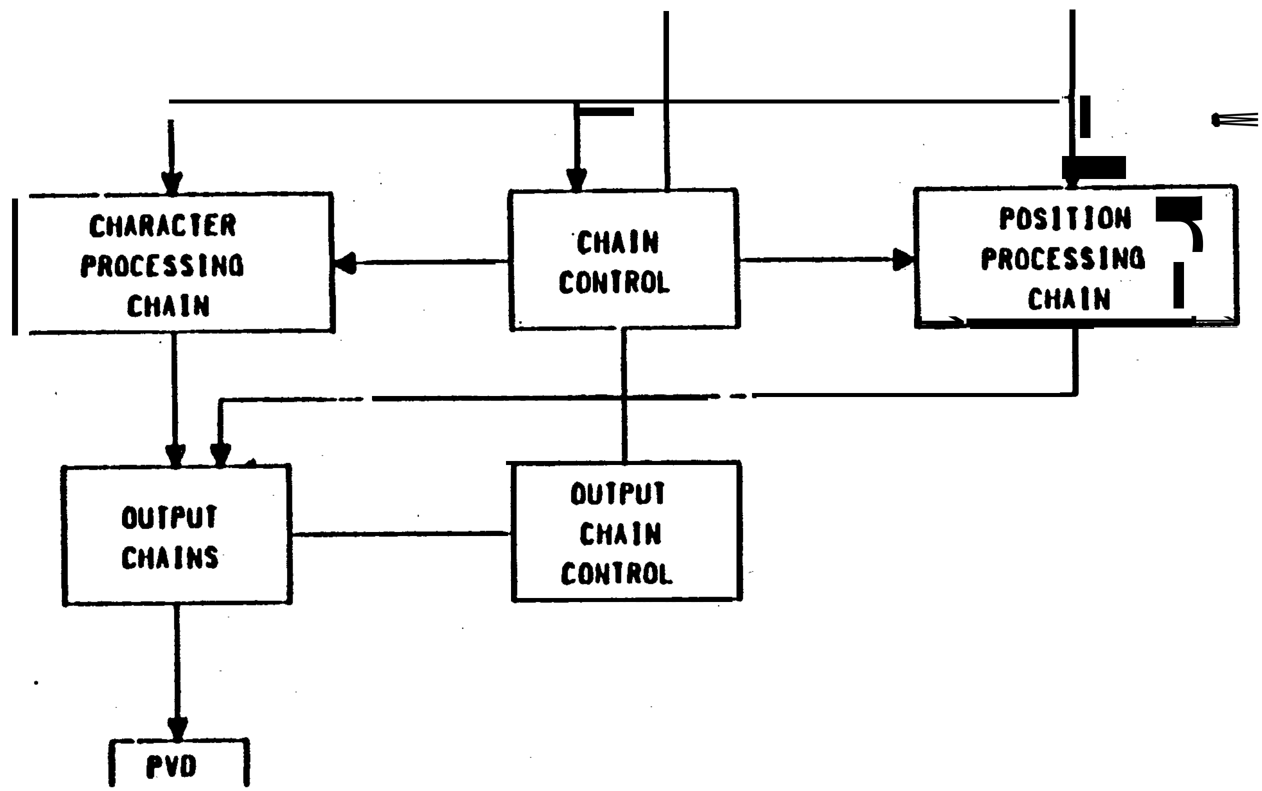


Figure 3.2.6.2-12. VGAC Processing Section

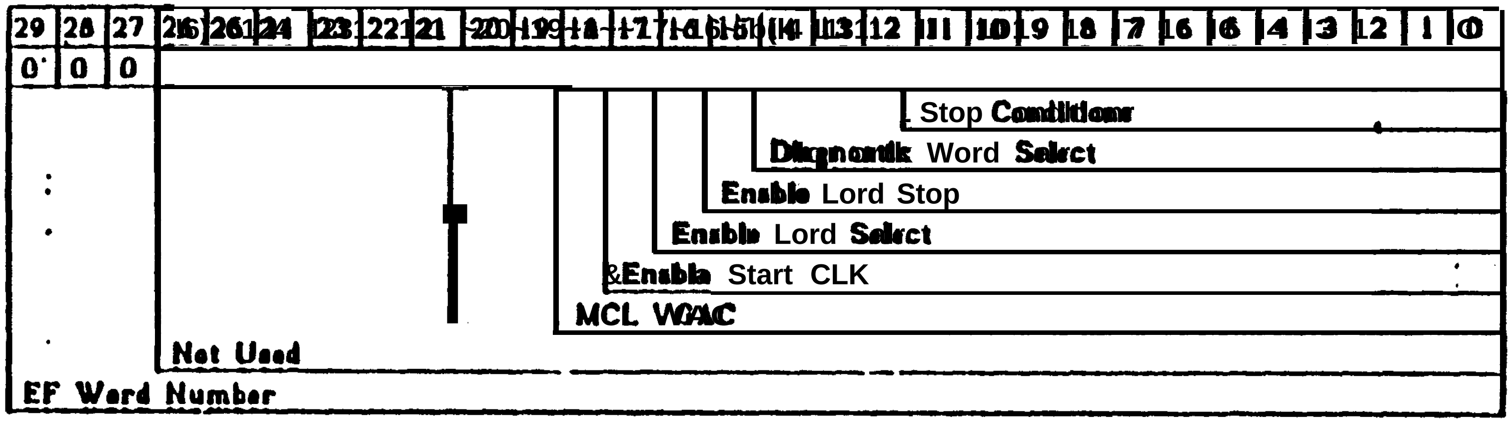


Figure X2.6.2-13. VDAC EF-0 Format

Bits 12-14 control the diagnostic multiplexer which selects diagnostic data to be sent back to the RBM. From the VGAC (only loaded if bit 16 is set).

14	13	12	Diagnostic word number
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

Contents of each diagnostic word will be defined at a later date.

Bit 15	Enables the loading of conditional stop bits 0-11.
Bit 16	Enables the loading of diagnostic select bits 12-14.
Bit 17	Starts VGAC CLK.
Bit 18	Master clear VGAC.
Bits 19-26	Unused.
Bits 27-29	EF Word 0

Bits 12-14 control the diagnostic multiplexer which selects diagnostic data to be sent back to the RBM. From the VGAC (only loaded if bit 16 is set).

14	13	12	Diagnostic word number
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

Contents of each diagnostic word will be defined at a later date.

Bit 15	Enables the loading of conditional stop bits 8-11.
Bit 16	Enables the loading of diagnostic select bits 12-14.
Bit 17	Starts VGAC CLK.
Bit 18	Master clear VGAC.
Bits 19-26	Unused.
Bits 27-29	EF Word 2

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	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
F-Word	EOS	MT			INTEN			np	DATA																1	1	1	1	1	1
PD-Word	0 0		Y-Coord (DSPL)										/////			0 0		X-Coord (DSPL)										////		0
W D-Word	CHAR #1						CHAR #2						CHAR #3						CHAR #4						CHAR #5					

Figure 3.2.6.2-16. General Word Formats

3.2.6.2.7.1.1 Refresh Data - Refresh data is requested by the VGAC and transferred upon receiving an acknowledge from the RBM. Three word formats are accepted by the VGAC.

F-Word

The general format for an F-word is shown in Figure 3.2.6.2-15.

Bits 0-5	77_8 always denotes F-word
Bits 6-21	Data dependent on message type
Bit 22	No process bit. VGAC will ignore all following data until a new F-word is detected.
Bits 23-25	Define intensity of data to be displayed.

25 24 23	Intensity category of data
0 0 0	Limited data block and history (PVD 0)
0 0 1	Radar and trackball (PVD 4)
0 1 0	Weather (PVD 2)
0 1 1	Not used (PVD 6)
1 0 0	Not used (PVD 1)
1 0 1	Targets and full data blocks and tabular data (PVD 5)
1 1 0	Map (PVD 3)
1 1 1	Not used (PVD 7)

Bits 26-28 Message type (see section 3.2.6.2.7.5 for detailed description of message types)

28 27 26	
0 0 0	No operation
0 0 1	Radar data block
0 1 0	Single symbol
0 1 1	Multiple symbol

3.2.6.2.7.12 Refresh Data – Refresh data is requested by the VGAC and transferred upon receiving an acknowledge from the RBM. Three word formats are accepted by the VGAC.

F-Word

The general format for an F-word is shown in Figure 3.2.6.2-15.

Bits 0-5	77_8 always denotes F-word
Bits 6-21	Data dependent on message type
Bit 22	No process bit. VGAC will ignore all following data until a new F-word is detected.
Bits 23-25	Define intensity of data to be displayed.

25 24 23	Intensity category of data
0 0 0	Limited data block and history (PVD 0)
0 0 1	Radar and track ball (PVD 4)
0 1 0	Weather (PVD 2)
0 1 1	Not used (PVD 6)
1 0 0	Not used (PVD 1)
1 0 1	Targets and full data blocks and tabular data (PVD 5)
1 1 0	Map (PVD 3)
1 1 1	Not used (PVD 7)

Bits 26-28 Message type (see section 3.2.6.2.7.5 for detailed description of message types)

28 27 26	
0 0 0	No operation
0 0 1	Radar data block
0 1 0	Single symbol
0 1 1	Multiple symbol

Vector end test error

Card 1 error

Card 2 error

Card 3 error

Card 4 error

On the occurance of any of these conditions an interrupt is sent to the RBM.

3.2.6.2.7.2 Processing Section - This section processes all data and prepares it for presentation to the output section. A firmware controller (chain controller Figure 3.2.6.2-12) controls two hardwired processing chains (position processing chain - character processing chain Figure 3.2.6.2-12).

3.2.6.2.7.2.1 Chain controller - The chain controller consists of a sequencer, a control PROM, and control logic. When an F-word is detected in the data register, all chains are initialized and the F-word is stored in the controller. The sequencer then jumps to a location in the PROM which is determined by the F-word. As the sequencer sequences through control PROM, successive instructions are loaded into the instruction register. These instructions along with stored F-word and EF word data determine which processing chains should be activated and what data should be gated into the chains. A request is sent to the I/O control section when additional data is required for processing. An acknowledge is received by the chain controller when data is available in the input buffer. A ready signal is held to the output section whenever processed data is available.

3.2.6.2.7.2.2 Position Processing Chain - This is a two function, hardwired sequential processing chain. On major position moves, it computes the distance moved from the old position to the new position. A count is then determined which corresponds to the time necessary for the PVD to make the move. (2.1μs+.55D for D greater than 0.3 inches) For vectors the chain computes the distance moved as with major position moves. This distance is then used to calculate the number of strokes necessary to draw the vector, a (brite) .15 μs/in or (dim) .30 in/μs vector. It also computes the ΔX and ΔY values for each stroke. The chain is stopped with the data until the output section accepts it. After the data is transferred, the chain becomes available again.

3.2.6.2.7.2.3 Character Processing Chain - This chain determines a count which corresponds to the time necessary for the PVD to paint the character (Figure 3.2.6.2-16). Nondisplayable characters are decoded and appropriate action taken. The chain stops and holds the count until the output section accepts it. After the data is transferred, the chain becomes available again.

6-Bit Octal Code	PVD Symbol	Paint Time In µS SML	Paint Time In µS LRG	6-Bit Octal Code	PVD Symbol	Paint Time In µS SML	Paint Time In µS LRG
0	SPACE	—	—	40	- (minus)	1.8	3.3
1	A	3.3	6.1	41	/ (slash)	4.5	8.7
2	B	4.2	8.1	42	S	3.3	6.3
3	C	3.0	5.7	43	T	3.0	5.7
4	D	3.3	6.3	44	U	3.6	6.9
5	E	4.5	8.7	45	V	3.6	6.9
6	F	3.3	6.1	46	W	5.7	11.1
7	G	3.3	6.1	47	X	4.5	8.7
10	H	4.2	8.1	50	Y	4.8	9.3
11	I	3.0	5.7	51	Z	5.7	11.1
12	◆	3.9	7.5	52	3	3.0	5.7
13	• (dot)	0.9	0.9	53	BLINK/ROLL [illegible]	-	-
14	Rectangle (tall)	3.6	6.9	54	[illegible] Flicker [illegible]	3.6	6.9
15	Rectangle (flat)	3.0	5.7	55	\	2.4	4.5
16	+ (plus)	5.1	9.9	56	NO OP	-	-
17	Escape	—	—	57	3	4.5	8.7
20	Carriage Return	—	—	60	0	4.2	8.1
21	J	2.4	4.5	61	1	1.8	3.3
22	K	4.2	8.1	62	2	3.9	7.5
23	L	3.0	5.7	63	3	3.9	7.5
24	M	4.8	9.3	64	4	3.6	6.9
25	N	3.9	7.5	65	5	3.3	6.3
26	O	3.3	6.3	66	6	3.6	6.9
27	P	3.3	6.3	67	7	2.7	5.1
30	Q	4.2	8.1	70	8	4.2	8.1
31	R	3.9	7.5	71	9	3.3	6.3
32	[illegible]	2.7	5.1	72	[illegible]	3.3	6.3
33	↓ (Arrow down)	3.6	6.9	73	↑ (Arrow up)	3.6	6.9
34	∧ (Accent)	1.8	3.3	74	[illegible]	4.8	9.3
35	Γ	2.1	3.9	75	[illegible]	4.5	8.7
36	[illegible]	5.7	11.1	76	[illegible]	4.5	8.7
37	[illegible]	3.6	6.9	77	ILLEGAL	-	-

Figure 3.2.26-16. Display Character and Control Codes

3.2.6.2.7.3 Output Section - The output section is responsible for taking processed data and transmitting it to the Plan View Display (PVD). It handles the timing for all data sent to the PVD.

3.2.6.2.7.3.1 Output Chain Controller - The output chain controller consists of a first done priority selector, and control logic. When a processing chain has data available the controller initiates the appropriate output chain. Other output chains are locked out until the initiated chain completes. The order in which processing chains become available with data is stored by the controller. Output chains are initiated in the same order that processing chains finish. When data from the processing section is loaded into the output section, the ready line from the processing section is cleared.

3.2.6.2.7.3.2 Output Chains - There are four hardwired output chains. The output major position chain accepts major position coordinates and count data from the position processing chain. It loads the output register to the PVD with the coordinates and times out.

The output vector chain accepts ΔX, and ΔY stroke size, number of strokes, and end point coordinates from the position processing chain. It then increments the output register to the PVD every 300ns until the vector is painted. To prevent hooks and bright spots, the vector is blanked, backed up two strokes when starting and allowed to overrun the end point by two strokes when finishing. On every vector, the actual endpoint is compared with the expected endpoint. A noncompare causes an interrupt to be sent to the IOM via the RBM.

The output character chain accepts the character code and paint time from the character processing chain. It loads the output register to the PVD with the character code and status information. It the times out on the character paint time count.

The intensity category chain compares the previous intensity category with that of the next chain to be started. If the category changes, a status word is loaded into the output register to the PVD. The status word contains the new intensity category to be used.

3.2.6.2.7.4 Diagnostic Section - The diagnostic section enables a diagnostic program in the IOM to check out the VGAC. EF word 0 controls the operation of the diagnostic section. The diagnostic control may stop the VGAC master clock on one of 12 possible preset diagnostic stop conditions. Eight 30 bit words (240 bits) of diagnostic data can be sent back to the IOM via the RBM. The diagnostic data is selected from key registers and control signals to isolate most errors to a single card. The VGAC clock is then enabled to restart and data processing is restarted where the stop occured.

3.2.6.2.5.5 Output Message Formats - Radar Data Block consists of 8 track symbol at the position given, then 8 radar, then 8 tab data. A radar data block consists of:

- 1 F-Word

3.2.6.2.7.3 Output Section - The output section is responsible for taking processed data and transmitting it to the Plan View Display (PVD). It handles the timing for all data sent to the PVD.

3.2.6.2.7.3.1 Output Chain Controller - The output chain controller consists of a first done priority selector, and control logic. When a processing chain has data available the controller initiates the appropriate output chain. Other output chains are locked out until the initiated chain completes. The order in which processing chains become available with data is stored by the controller. Output chains are initiated in the same order that processing chains finish. When data from the processing section is loaded into the output section, the ready line from the processing section is cleared.

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The output character chain accepts the character code and paint time from the character processing chain. It loads the output register to the PVD with the character code and status information. It the times out on the character paint time count.

The intensity category chain compares the previous intensity category with that of the next chain to be started. If the category changes, a status word is loaded into the output register to the PVD. The status word contains the new intensity category to be used.

3.2.6.2.7.4 Diagnostic Section - The diagnostic section enables a diagnostic program in the IOM to check out the VGAC. EF word 0 controls the operation of the diagnostic section. The diagnostic control may stop the VGAC master clock on one of 12 possible preset diagnostic stop conditions. Eight 30 bit words (240 bits) of diagnostic data can be sent back to the IOM via the RBM. The diagnostic data is selected from key registers and control signals to isolate most errors to a single card. The VGAC clock is then enabled to restart and data processing is restarted where the stop occured.

3.2.6.2.7.5 Output Message Formats - Radar Data Block consists of 8 track symbol at the position given, then 8 leader, then 8 tab data. A radar data block consists of:

- 1 F-Word

Bit 22 NP = No process. VGAC will not display data.

Bits 23-25 I = Intensity of the data block.

Bits 26-28 MT = Message type = 001

Bit 29 = 0

An escape code (17_8) found anywhere within the character portion of the data block, denotes the end of the data block.

__Tabular Message Format__ (see Figure 3.2.6.2-17B.) The tabular data message is similar to the radar data block format. Tabular data messages consist of:

1 F-word

1 P_D-word

"N" W_B words

All data in the data character portion of the format are processed as characters until and escape (17_8) is found or until a 77_8 code is found in bits 0-5 (indicating a new F-word).

__Tabular Data Message F-word Definitions:__

Bits 0-5	All 1's (Indicates F-word)
Bits 6-11	Unused
Bit 12	S Size
Bit 13	Unused
Bit 14	Unused
Bits 15-19	Unused
Bit 20	BL-starting blink
Bit 21	Unused
Bit 22	NP = no process bit
Bits 23-25	I = block intensity
Bits 26-28	Message type = 001

Bit 29 : EOS = 0 =

Single Symbol and (EOD/SOD) formats are shown in Figures 3.2.6.2-18,-19.

F-Word Field Definitions:

Bits 0-5	077_8 (indicates F-word)
Bits 6-11	Symbol to be displayed
Bit 12	S - Sizes
	0 = small
	1 = large
Bit 13	BL - character blink
Bit 14	Unused
Bits 15-18	Unused
Bit 19	BO - beacon only (over write symbol with a "/" symbol)
Bit 20	Unused
Bit 21	EOD bit (end of display bit) should be set equal to zero for single symbol data
Bit 22	NP = no process bit
Bits 23-25	I-intensity
Bits 26-28	MT Message type = 010
Bit 29	EOS = 0

The end of display message is a special format formed from a single symbol word. This message (see Figure 3.2.6.2-19) must occur once per refresh. It is used to key the 55 Hz cycle and to position the beam at the center of the scope (thus, turning off the deflection amplifiers) during times when no data is to be displayed.

Multiple Symbol Format (see Figure 3.2.6.2-20.) This message format is a variable length format, dependent on the number of symbols to be displayed (1 to 5). Each character to be displayed will be displayed at the intensity specified; however, each character will have separate:

- coordinates

Bit 29 : EOS = 0 =

Single Symbol and (EOD/SOD) formats are shown in Figures 3.2.6.2-18, -19.

F-Word Field Definitions:

Bits 0-5	077_8 (indicates F-word)
Bits 6-11	Symbol to be displayed
Bit 12	S - Sizes 0 = small 1 = large
Bit 13	BL - character blink
Bit 14	Unused
Bits 15-18	Unused
Bit 19	BO - beacon only (over write symbol with a "/" symbol)
Bit 20	Unused
Bit 21	EOD bit (end of display bit) should be set equal to zero for single symbol data
Bit 22	NP = no process bit
Bits 23-25	I-intensity
Bits 26-28	MT Message type = 010
Bit 29	EOS = 0

The end of display message is a special format formed from a single symbol word. This message (see Figure 3.2.6.2-19) must occur once per refresh. It is used to key the 55 Hz cycle and to position the beam at the center of the scope (thus, turning off the deflection amplifiers) during times when no data is to be displayed.

<u>Multiple Symbol Format</u> (see Figure 3.2.6.2-20.) This message format is a variable length format, dependent on the number of symbols to be displayed (1 to 5). Each character to be displayed will be displayed at the intensity specified; however, each character will have separate:

- coordinates

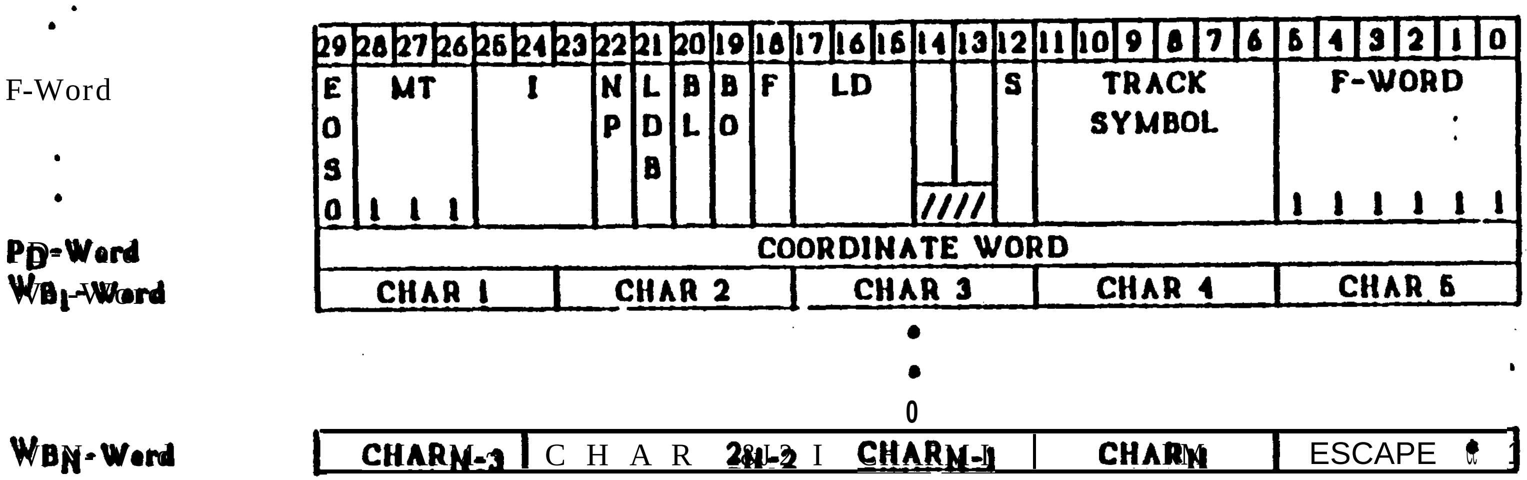
[illegible]

Bit 13	BL - character blank
Bit 14	Not used
Bit 15	P2 - display character at coordinate #2
Bit 16	P1 - display character at coordinate #1
Bits 17-18	VT - Vector Type
	00 = blank vector
	01 = solid vector
	10 = short dash vector
	11 = long dash vector
Bit 19	BV - blank vector
Bit 20	Not used
Bit 21	T - next vector bit should be equal to 0 for vector data
Bits 23-25	I - Intensity
Bits 26-28	MT Message type = 100
Bit 29	ECS = 0

	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
F-Word	EOSO	MT			I			NP	LDB	BL	BO	F	LD			////		S	TRACK SYMBOL						F-WORD					
PD-Word	COORDINATE WORD																													
WB1-Word	CHAR 1						CHAR 2						CHAR 3						CHAR 4						CHAR 5					
⋮																														
WBN-Word	CHAR N-3						CHAR N-2						CHAR N-1						CHAR N						ESCAPE *					

* Escape may be any of the five characters.

Figure 3.2.6.2-17A. Data Block Message Format (VGAC)



* Escape may be any of the five characters.

Figure 3.2.6.2-17A. Data Block Message Format (WAC)

Bit	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
F-Word	EOSO	MT			I			NP	EOD	NU	BLO	UNUSED				C	BL	S	SYMBOL						F-WORD					
	0	0	1	0								//////													1	1	1	1	1	1
P-Word (PD)	COORDINATE WORD																													

Figure 3.2.6.2-18. Single Symbol (VGAC)

Bit	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
F-Word	EOSO	MT			I			NP	EOD		BO	UNUSED					BL	S	SYMBOL						F-WORD					
	0	0	1	0	0	0	0	0	1	///	0	//////					0	0	0	0	0	0	0	0	1	1	1	1	1	1
P-Word	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

Figure 3.2.6.2-19. EOD/SOD (Special Format) (VGAC)

	29	28 27 26	25 24 23	22	21	20	19	18 17 16 15	14	13	12	11 10 9 8 7 6	5 4 3 2 1 0
F-Word	EOS0	MT	I	NP	EOD	NU	BLO	UNUSED	C	BL	S	SYMBOL	F-WORD
		0 1 0						//////////////					1 1 1 1 1 1
P-Word (PD)	COORDINATE WORD												

Figure 3.2.6.2-18. Single Symbol (VGAC)

	29	28 27 26	25 24 23	22	21	20	19	18 17 16 15 14	13	12	11 10 9 8 7 6	5 4 3 2 1 0
F-Word	EOSO	MT	I	NP	EOD		BO	UNUSED	BL	S	SYMBOL	F-WORD
	0	0 1 0	0 0 0	0	1	///	0	//////////////	0	0	0 0 0 0 0 0	1 1 1 1 1 1
P-Word	0	0 1 0	0 0 0	0	0	0	0	0 0 0 0 0	0	1	0 0 0 0 0 0	0 0 0 0 0 0

Figure 3.2.6.2-19. EOD/SOD (Special Format) (VGAC)

	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
F-Word	E	MT			I			N	T	N	B	VT		P	P		B	S	CHAR						F-WORD					
	O							P		U	V			1	2		L													
	S																													
	0	1	0	0					0							//									1	1	1	1	1	1
P_D Words	COORDINATE WORD 1																													
	COORDINATE WORD 2																													

Figure 3.2.6.2-21. Major Position and Vector

	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
F-Word	E	MT			I			N	T		B	VT		P	P		B	S	CHAR						F-WORD					
	O							P			V			1	2		L													
	S																													
	0	1	0	0					1	//						//									1	1	1	1	1	1
P_D Words	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0

Figure 3.2.6.2-22. Test Vector

3.2.6.3 Interface Requirements -

3.2.6.3.1 IBAG/IOP Interface - The IBAG/IOP Interface will provide for Input/Output (I/O) to 4 (four) separate and independent IBAG channels (A,B,C and D). Data, status and command words will be transferred between the IBAG channel and the IOP by 32 (thirty-two) bit (including 2 [two] parity) parallel data channels meeting the requirements specified in SB 10205.

3.2.6.3.2 IBAG/PVD Interface - The IBAG/PVD Interface will transfer the X, Y position data, character codes, and control information to the PVD. The IBAG will provide an interface for up to 6 (six) PVD's at a cable length of 300 (three hundred) feet each. This interface will meet the requirements defined for the PVD in FA-7912 maintenance manual for the PVD.

3.2.6.3.3 PVD Control - The IBAG will provide control information for the correct identification and display of data sent to the PVD. This control information will be transferred via 4 (four) twisted pair lines. One line provides the clock for PVD synchronization and the other 3 (three) combine to permit specification of 8 (eight) PVD status criteria necessary to display the transferred data and character information. The IBAG/PVD interface lines are shown in Figure 3.2.6.3-1.

3.2.6.3.3.1 Data and Character Information - The position data transfer lines between the IBAG and the PVD will consist of 26 (twenty-six) twisted pair lines, 13 (thirteen) for X positioning data and 13 for Y positioning data. It will be required to multiplex character data and control on these position data lines.

3.2.6.3.4 R Controls - The IBAG will provide control information for the proper identification of data sent to the R Control logic. It will also provide for input data sent from the R Controls to provide Status, Console Constants, and Keyboard/Trackball information. This information will be transferred over 5 (five) twisted pair lines. (See Figure 3.2.6.3-1)

3.2.6.3 Interface Requirements -

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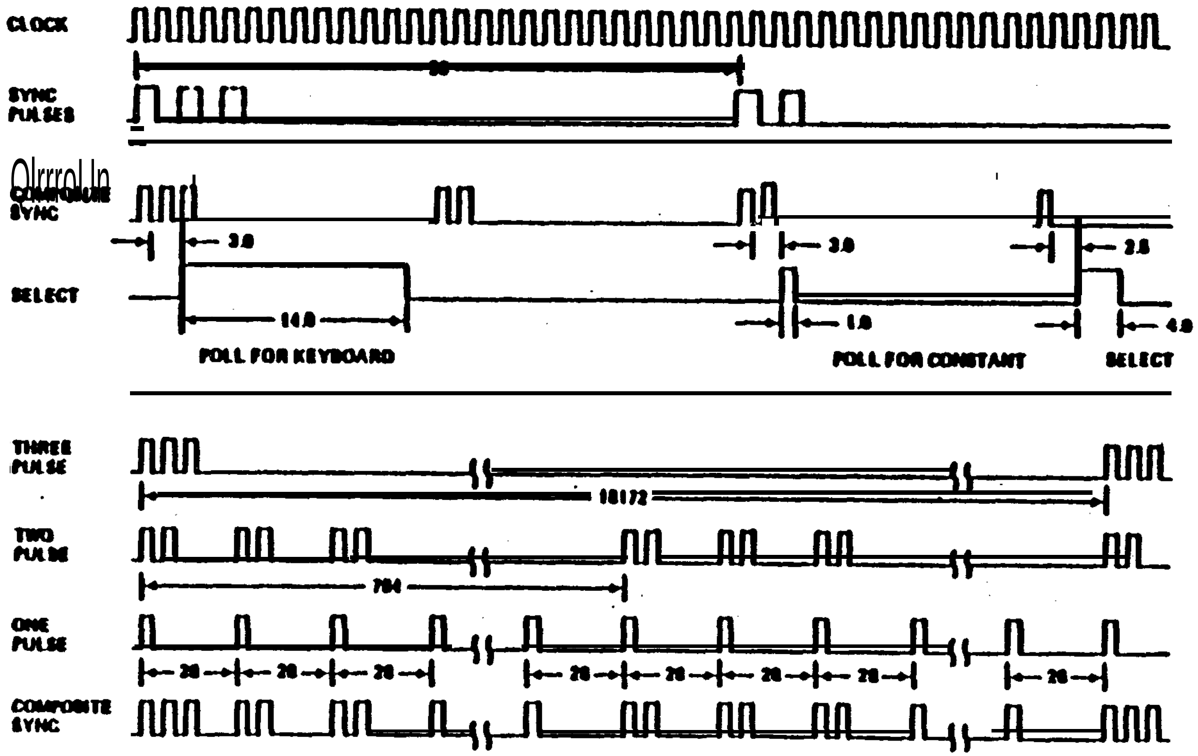

Figure 3.2.6.3-2, R - Controls Sync Diagram

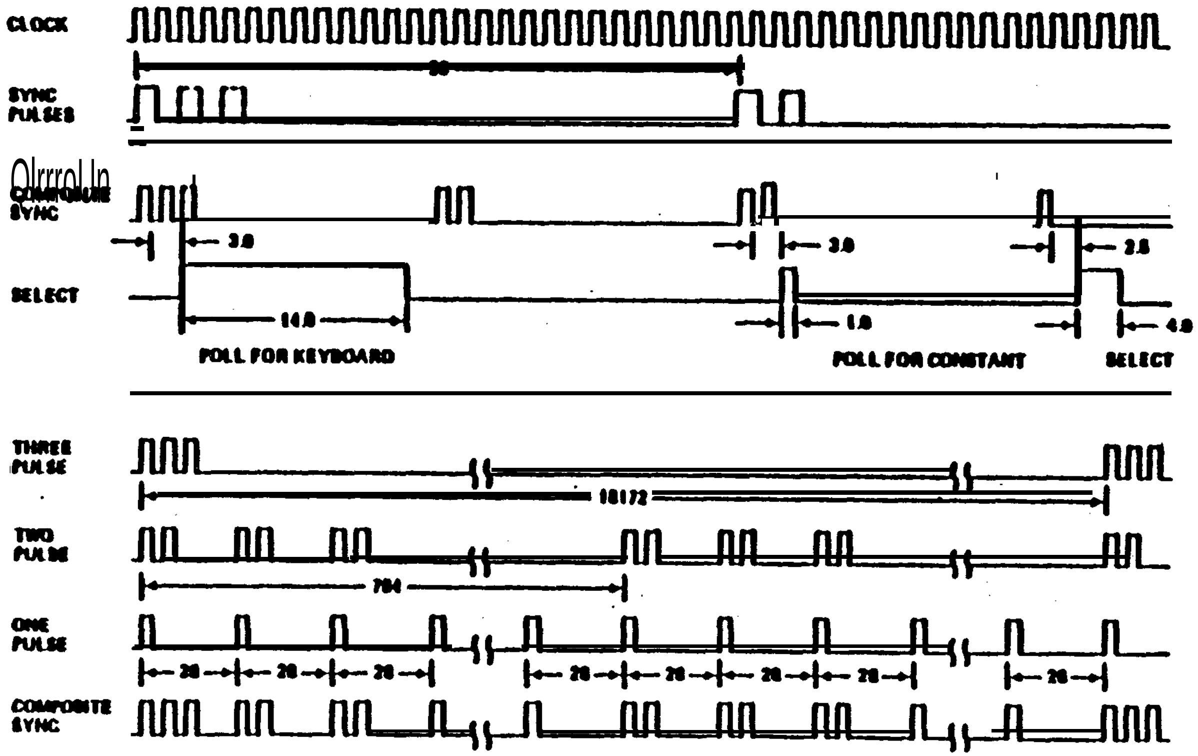

Figure 3.2.6.3-2, R - Controls Sync Diagram

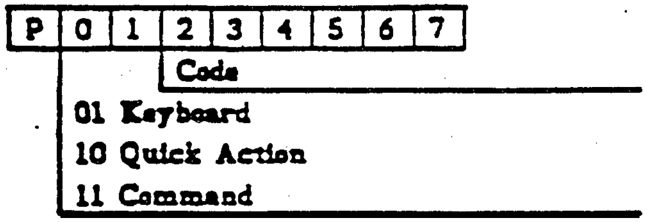

Figure 3.2.6.3-3. Keyboard Input Byte

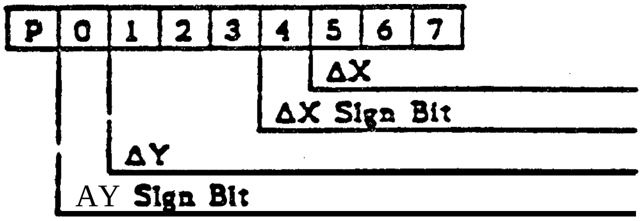

Figure 3.2.6.3-4. Trackball Input Byte

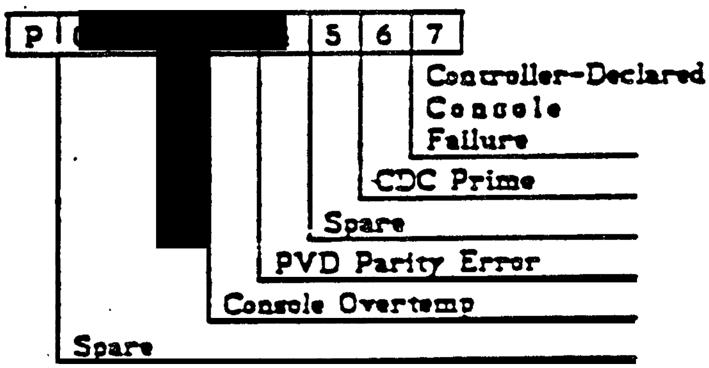

Figure 3.2.6.3-5. Display Constants Byte 1

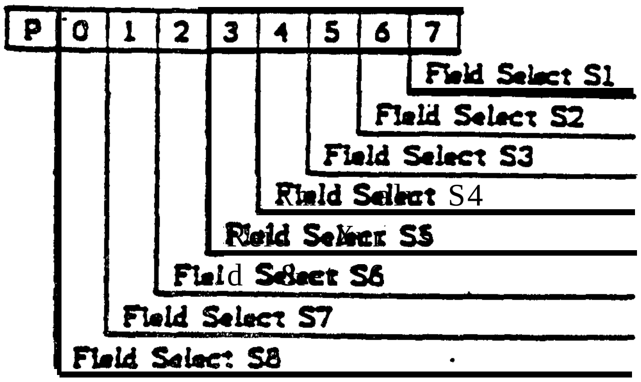

Figure 3.2.6.3-6. Display Constants Byte 2

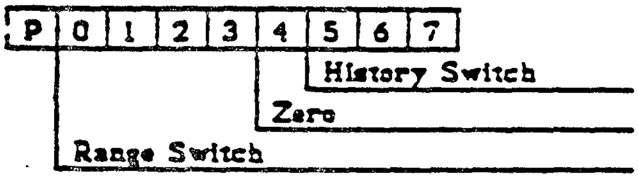

Figure 3.2.6.3-7. Display Constants Byte 3

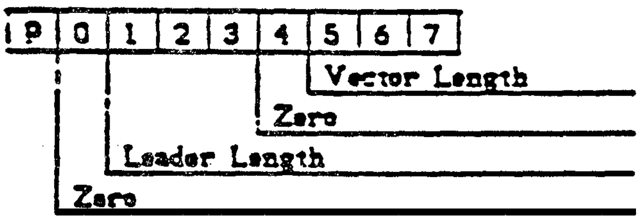

Figure 3.2.6.3-8. Display Constants Byte 4

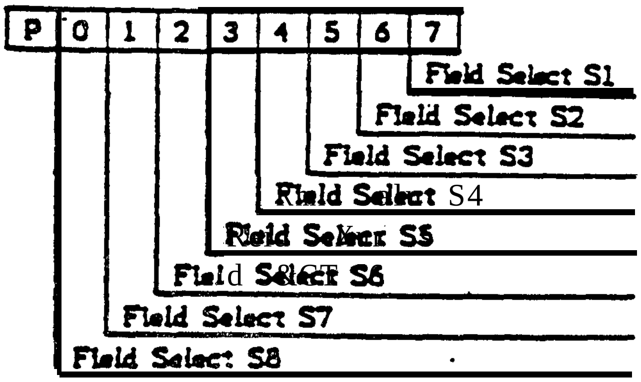

Figure 3.2.6.3-6. Display Constants Byte 2

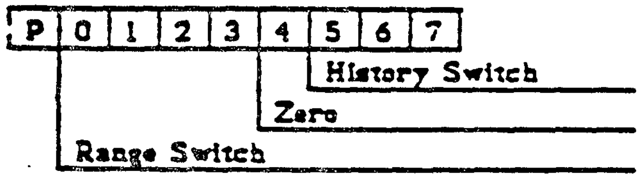

Figure 3.2.6.3-7. Display Constants Byte 3

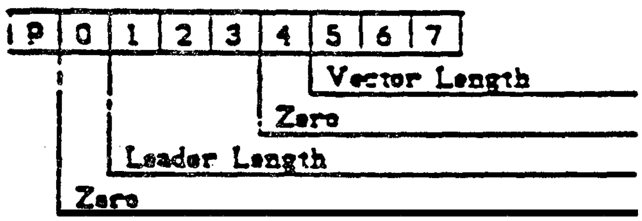

Figure 3.2.6.3-8. Display Constants Byte 4

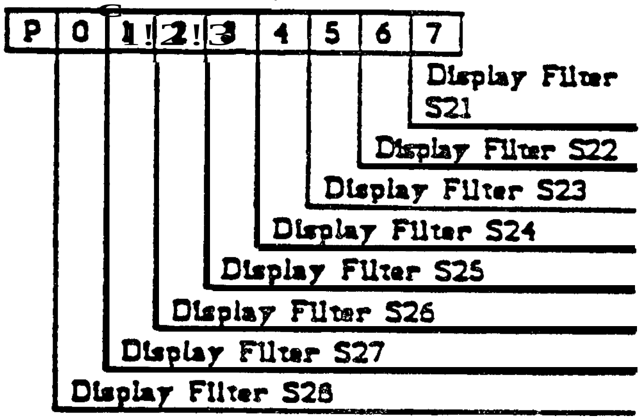

Figure 3.2.6.3-12. Display Constants Byte 8

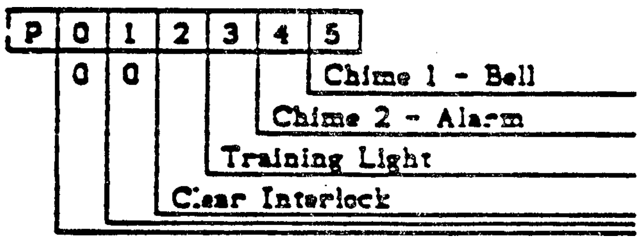

Figure 3.2.6.3-13, Keyboard Status Word

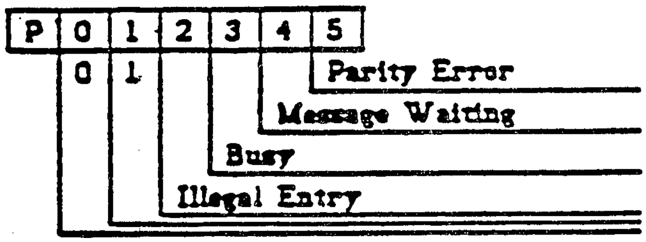

Figure 3.2.6.3-14. Keyboard Status Word 2

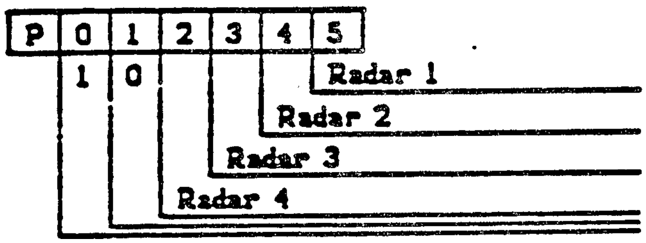

Figure 3.2.6.3-15. Keyboard Status Word 3

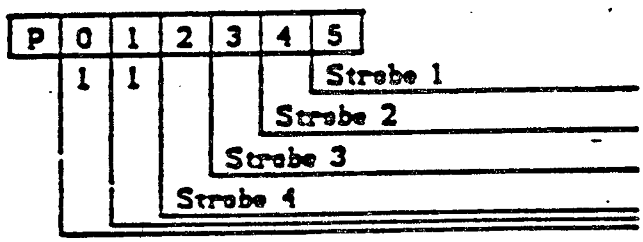

Figure 3.2.6.3-16. Keyboard Status Word 4

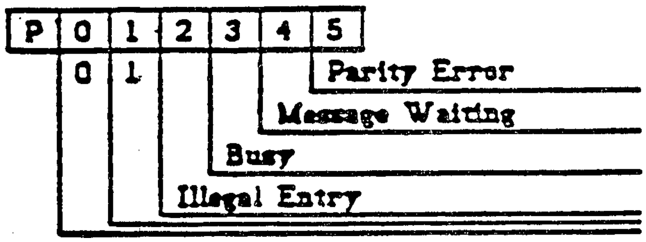

Figure 3.2.6.3-14. Keyboard Status Word 2

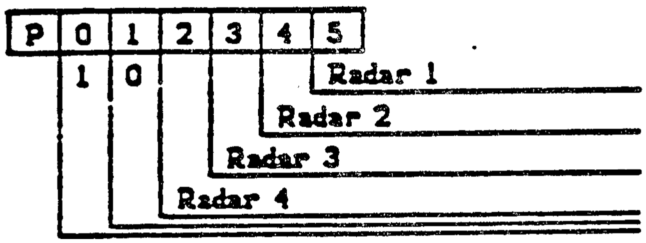

Figure 3.2.6.3-15. Keyboard Status Word 3

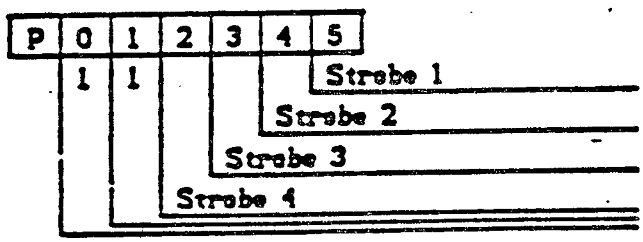

Figure 3.2.6.3-16. Keyboard Status Word 4

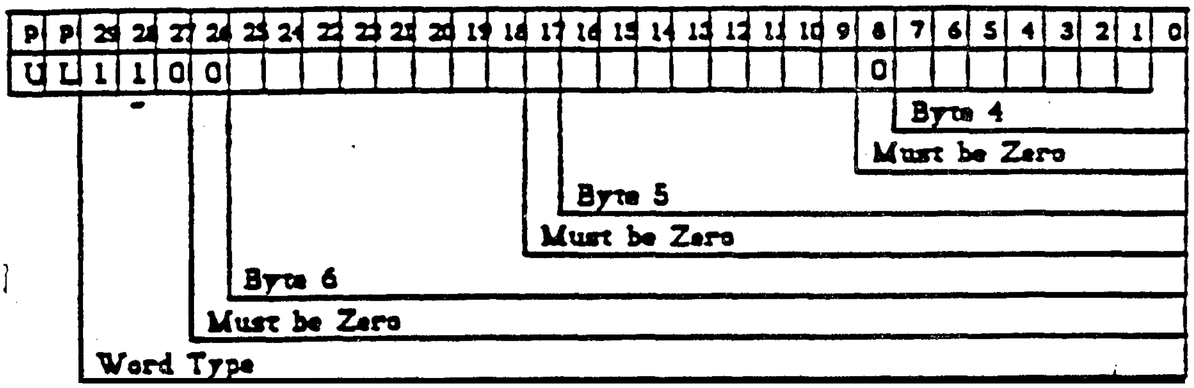

Figure 3.2.6.3-20. Type 6 Input Word

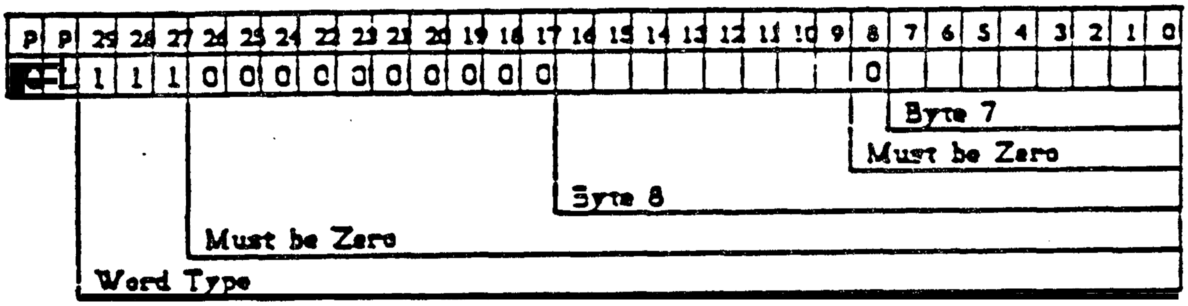

Figure 3.2.6.3-21, Type 7 Input word

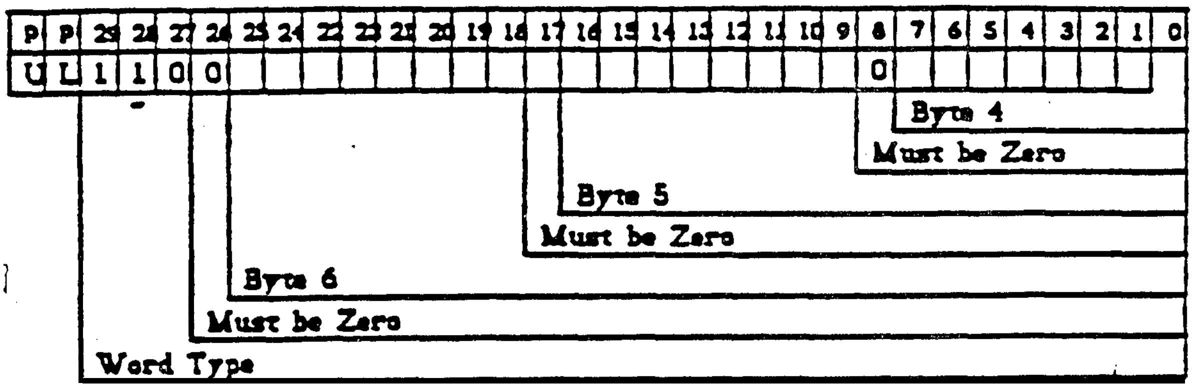

Figure 3.2.6.3-20. Type 6 Input Word

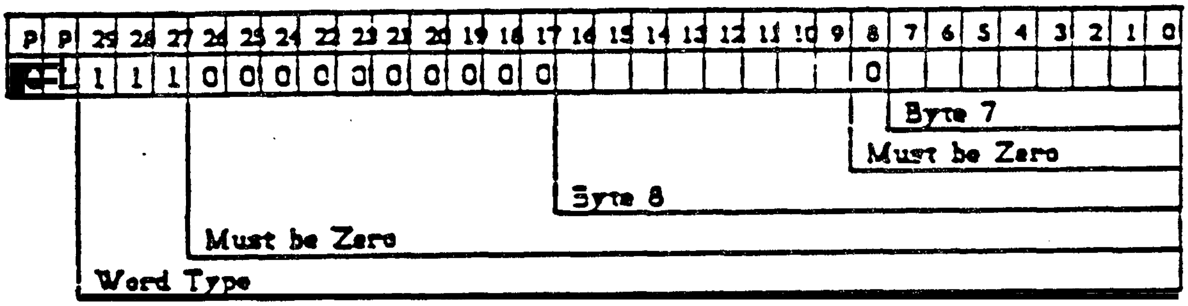

Figure 3.2.6.3-21. Type 7 Input Word

TABLE 3.2.6.3-1. KEYBOARD DATA BYTE #1 (continued)

Identification	Octal Code (8-Bits)	Comment
Z -	151	Keyboard Characters
* (Star)	153	Keyboard Characters
⊖ (Overcast)	155	Keyboard Characters
?	157	Keyboard Characters
0	160	Keyboard Characters
1	161	Keyboard Characters
2	162	Keyboard Characters
3	163	Keyboard Characters
4	164	Keyboard Characters
5	165	Keyboard Characters
6	166	Keyboard Characters
7	167	Keyboard Characters
8	170	Keyboard Characters
9	171	Keyboard Characters
↑	173	Keyboard Characters
■	174	Keyboard Characters
→	176	Keyboard Characters
Off-Center Preset	313	System Status
Off-Center Manual	316	Control Panel
Home (Trackball)	312	Trackball
Enter (Trackball)	311	Trackball
Back Line (Enter)	301	Keyboard Commands
Skip	303	Keyboard Commands
Skip Auto	304	Keyboard Commands
Backspace	305	Keyboard Commands
Backspace Auto	306	Keyboard Commands
CR/LF	307	Keyboard Commands
Clear	310	Keyboard Commands
CRD ACK	314	Keyboard Commands
ILL	315	Keyboard Commands
S1 -	201	Quick Action Controls
S2 -	202	Quick Action Controls
S3 -	203	Quick Action Controls
S4 -	204	Quick Action Controls
S5 -	205	Quick Action Controls

TABLE 3.2.6.3-L KEYBOARD DATA BYTE #1 (continued)

Identification	Octal Code (8-Bits)	Comment
S6 - F13	206	Quick Action Controls
S7 - F14	207	Quick Action Controls
S8 - F15	210	Quick Action Controls
S9 - F16	211	Quick Action Controls
S10 -	212	Quick Action Controls
S11 - F9	213	Quick Action Controls
S12 - F10	214	Quick Action Controls
S13 - F11	215	Quick Action Controls
S14 - F12	216	Quick Action Controls
S15 -	217	Quick Action Controls
S16 - HND Off	361	Category Select Keys
S17 - FLT Data	362	Category Select Keys
S18 - Multi Func.	363	Category Select Keys
S19 - F8	364	Category Select Keys
S20 -	365	Category Select Keys
S21 - TRK Start	366	Category Select Keys
S22 - TRK Repos	367	Category Select Keys
S23 - TRK SUSP	370	Category Select Keys
S24 - TRK Drop	371	Category Select Keys
S25 -	372	Category Select Keys
S1 -	341	RCRD Function Keys
S2 -	342	RCRD Function Keys
S3 -	343	RCRD Function Keys
S4 -	344	RCRD Function Keys
S5 -	345	RCRD Function Keys
S6 -	346	RCRD Function Keys
S7 -	347	RCRD Function Keys
S8 -	350	RCRD Function Keys
S9 -	351	RCRD Function Keys
S10 -	352	RCRD Function Keys

3.2.6.4 Panel Switches and Indicators - A complete set of controls and indicators are provided for both operating and maintenance personnel. The front swing out door of the drawers contains the control panel that includes those items necessary for turning on the modules, running programs and for observing its operation. It provides an effective aid to general servicing and a means to run the diagnostic routine.

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	by the Diag program.
	ON LINE MODE - Indicates which DB number is in the discrete register.
	MASTER CLEAR - Indicates which DB is being tested by the Bus test.
TEST GO	Indicates the Diag program ran with no errs.
F 6 AMP (AC)	Holds fuse for AC Power to Logic, lights when fuse is blown
Micro Mode (3 Position Switch)	
Run (up)	The MPC is executing micro-instructions in high speed.
STOP (center)	The MPC is not executing micro-instructions
STEP (down)	The MPC will execute one instruction each time the switch is pressed.
Micro Run (Indicator)	Lights when the MPC is executing micro-instructions in high speed.
Micro Stop (Indicator)	Lights when MPC is stopped by microinstruction F = 15 D = 4
Master Clr (Switch)	Depressing the switch when the MPC is not in the run mode; places the IOM in an initial state.
Online/Diag	Online - the instructions will come from the operational firmware. Diag - the instructions will come from the diagnostic firmware
Chan Enable (3 position)	
A C	IOP A/C only can talk to IOM
AB CD	IOP A/C and IOP B/D can talk to IOM
B D	IOP B/D only can talk to IOM
Control Indicator	A light lit means A has control
	B light lit means B has control
	C light lit means C has control

	D light lit means D has control
Jump	
1	Jump 1 up causes microprogram to execute the micro-branch instruction.
2	Jump 2 up causes microprogram to execute the micro-branch instruction.

3.2.6.5 <u>Maintenance Features</u> - The Interface Buffer Adapter and Generator (IBAG) will contain maintenance features for system verification. These maintenance features will be built into the IBAG and may be initiated from the IOM maintenance panel or the ICP.

Off-line system verification will be accomplished by utilizing the built in test equipment (BITE) and micro-diagnostic firmware. Functional partitioning of the IBAG hardware will enable an efficient method of isolating faults utilizing the diagnostic firmware. The primary goal of the off-line diagnostic is to supply card isolation; however, the firmware will be so structured as to aid in subsystem maintenance.

3.2.6.5.1 Diag Firmware - The off-line diagnostic test is an automatic test initiated by diagnostic switches located on each IOM maintenance panel. These switches will be used to select various modes of program operation. The modes include options to recycle the entire program, to select additional error display information on the maintenance panel, and the ability to cycle a program module.

The diagnostic tests will exercise in order, the I/O module (IOM) and Display Module (DM) sections. The diagnostic tests will use a building block method for testing. In the Display Buffer Control section of the IOM, the simplest to the most complex functions are tested. In each of the Processor Input and Channel Control sections of the IOM, a control and end around data test is used for isolation. In the Refresh Buffer Memory section of the DM, isolation is accomplished with a control test and memory data write/read test.

The Vector Generator and Character section of the DM uses a front end stimulation and card output readback method for isolation. The Control Input section of the IOM uses a control test and end around test to accomplish isolation.

The Plan View Display (PVD) is blanked during the execution of the off-line diagnostic firmware.

If the firmware detects an error in the IBAG, the fault will be indicated at the IBAG maintenance panels. The display register indicators will be correlated to card locations in the case of IOM errors. The combination of display register, DM available indicators and DM card error indicators will be correlated to card locations in the case of DM

	D light lit means D has control
Jump	
1	Jump 1 up causes microprogram to execute the micro-branch instruction.
2	Jump 2 up causes microprogram to execute the micro-branch instruction.

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The Plan View Display (PVD) is blanked during the execution of the off-line diagnostic firmware.

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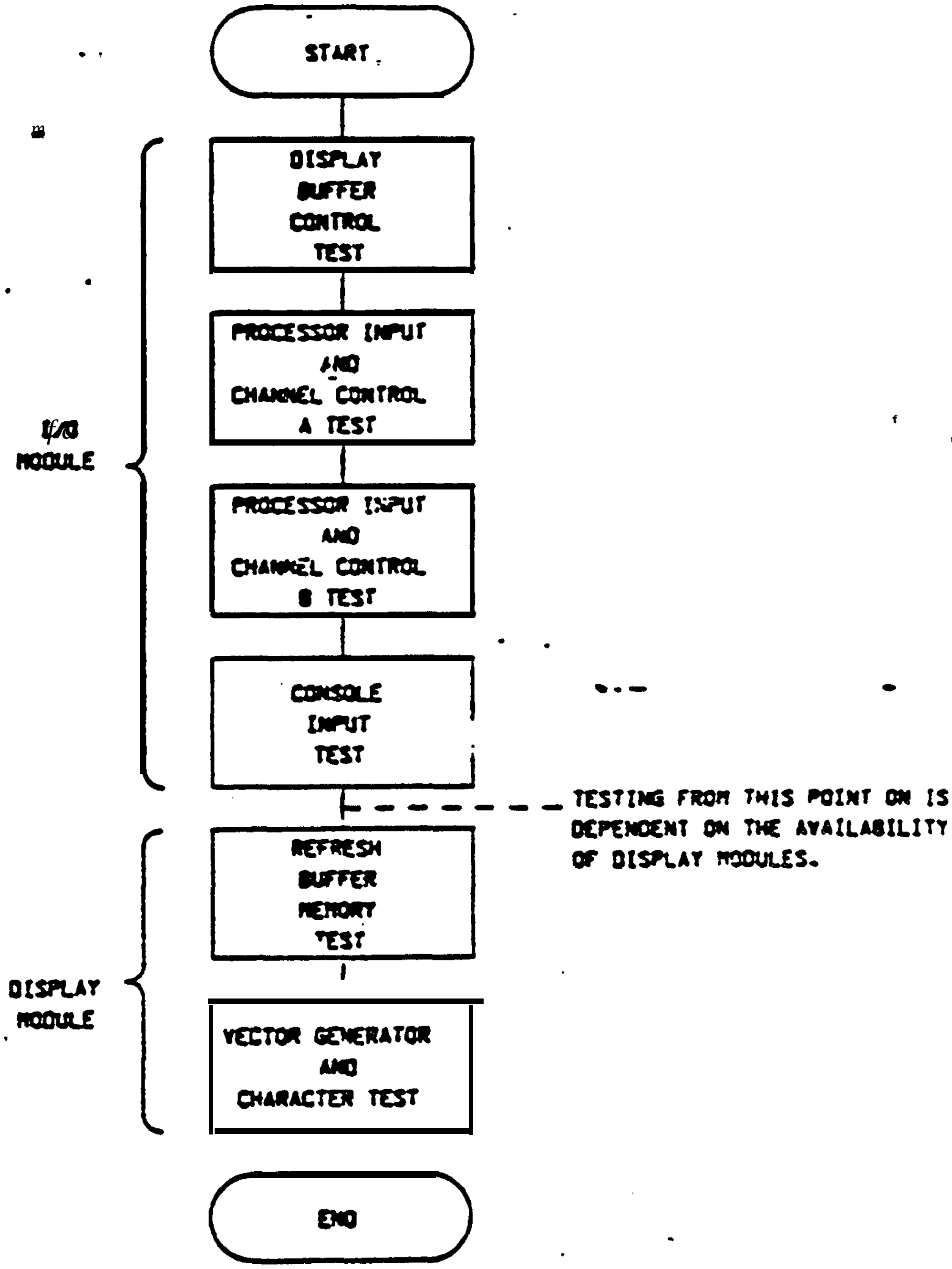

Figure 3.2.6.5-1. IBAG Off-line Diagnostic Test Flow

3.2.6.6 Mechanical -

3.2.6.6.1 Rack Design -- The rack is a cold rolled steel (C.R.S.) bolted welded cabinet. the front and rear angles are drilled or tapped in a standard RETMA/EIA hole pattern to accommodate standard 19" panels.

The rear of the rack includes a C.R.S. door with a single point flush cup latch and is mounted on spring loaded hinge pins. The top of the rack has an opening to which the connector panel is mounted providing a transfer cable connection between the drawer modules mounted in the rack and other units in the system. The bottom of the rack includes four (4) reinforcing pads with 5/8" diag. holes making the rack boltable to the floor.

The design is such as to make the following an integral part of the rack.

1. The control panel assembly is located at the top front of the rack. The assembly includes two circuit breakers, a 15 amp breaker for utility power (duplex outlets) and a 50 amp breaker for the rack power. In addition the assembly includes a duplex outlet, five 15A indicating fuses for the plug in strip outlets, and a covered terminal board of such design as to meet all the requirements for the AC power connections.

2. The blower and filter assembly is located on the bottom front of the rack. The blowers supply 400 cfm of air at 0.15" S.P. thus maintaining a positive pressure in the rack and furnishing sufficient air for all the drawer modules. The blowers are plugged into the plug in strip and are turned on when the main power to the rack is turned on. The filters are readily removeable, from the front, for cleaning.

3. The plug in strip has a sufficient number of duplex outlets to plug in the various drawer modules and the blower assembly. Each duplex outlet is rated for 15 amps, 120 VAC.

4. The chassis ground bus is capable of grounding all of the drawer modules in the rack and has a stud for connection to the system ground.

5. The signal ground bus is insulated from the rack and serves as a common signal grounding of all drawer modules in the rack.

6. The two utility duplex outlets are on the separate circuit which is rated for 15 amps, 120 VAC. One outlet is located on the control panel and the second one is located below the door on the rear of the rack.

Wherever possible, all cabling within the rack is done with flat cables. These cables connect the various drawer modules to the connector panel(s) fastened to the top of the rack. Cable clamps and cable brackets are used to hold the cables neatly and to provide the necessary service loops.

The main power requirements for the rack with four drawer modules, blowers, etc. is 5 KVA. With an electrical load of 5 KVA the heat dissipated will be approximately 17,100 BTUs.

The blowers in the rack and those in each drawer module are rubber mounted. Because of the method of mounting and the type of blowers used, the noise levels, on a per rack basis, will not exceed the noise levels of Condition A of FAA-G-2100 Section 1-3.5.11.

The weight of the rack and cables shall not exceed 500 lbs. The rack weight plus four drawer modules with a weight of 125 lbs. each equals 1000lbs. for a fully loaded unit. The floor area of each footprint rack is 24" x 30" thus the floor loading of a fully loaded unit will not exceed 200 lbs/sq. ft.

The working shadow is 24 x 96 and the distributed load will be 67lbs/square feet.

For physical dimensions see Figures 3.2.6.6-1 and 3.2.6.6-2.

For maintenance dimensions see Figures 3.2.6.6-3 and 3.2.6.6-4.

3.2.6.6.2 Drawer Module Design - The design of the drawer modules is such as to be divided into three major divisions.

1. The indicator panel assembly, which includes all of the various indicators, switches, fuses, etc., is hinged at the front panel allowing access to the rear of the panel and the PC boards.

2. The PC boards chassis which is hinged at the power supply chassis allowing access to the wire wrapped back panel, the blower, and the terminal boards.

3. The power supply chassis contains the power supply, blower, air filters, connector panel, slides, air filters, etc.

The design of the drawer modules is such that all drawers are of the same mechanical dimensions thus being physically interchangeable. Further, the design is such as to take advantage of the commonality of the parts. The only difference being those required by the variations in functions of the drawers.

Each drawer module has its own blower which draws air in through the air filters, through the power supply and PC boards, and exhausting around the indicator panel. The blower furnishes 100 cfm of air at 0.25" S.P. which is sufficient to maintain a 15°C Δ T with an electrical load of 800 watts. With an electrical load of 800 watts each drawer module will dissipate approximately 2800 BTUs of heat. The power wiring is such as to make it impossible to energize the functional elements without the blower being turned on.

A temp/flow switch, located just inside of the air inlet, closes on excessive temperature rise or loss of airflow. Upon closing the temp/flow switch activates both visual (light)

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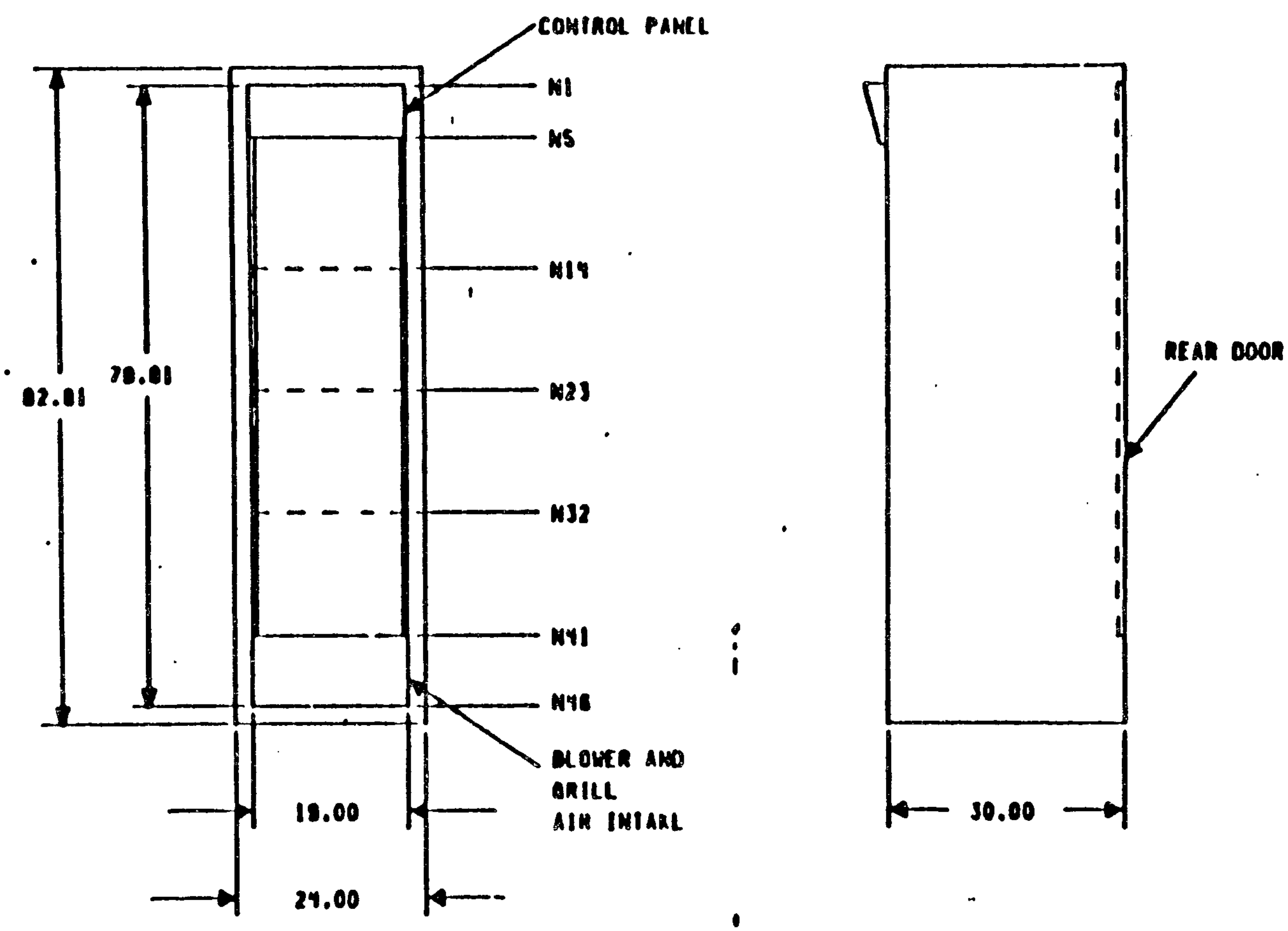
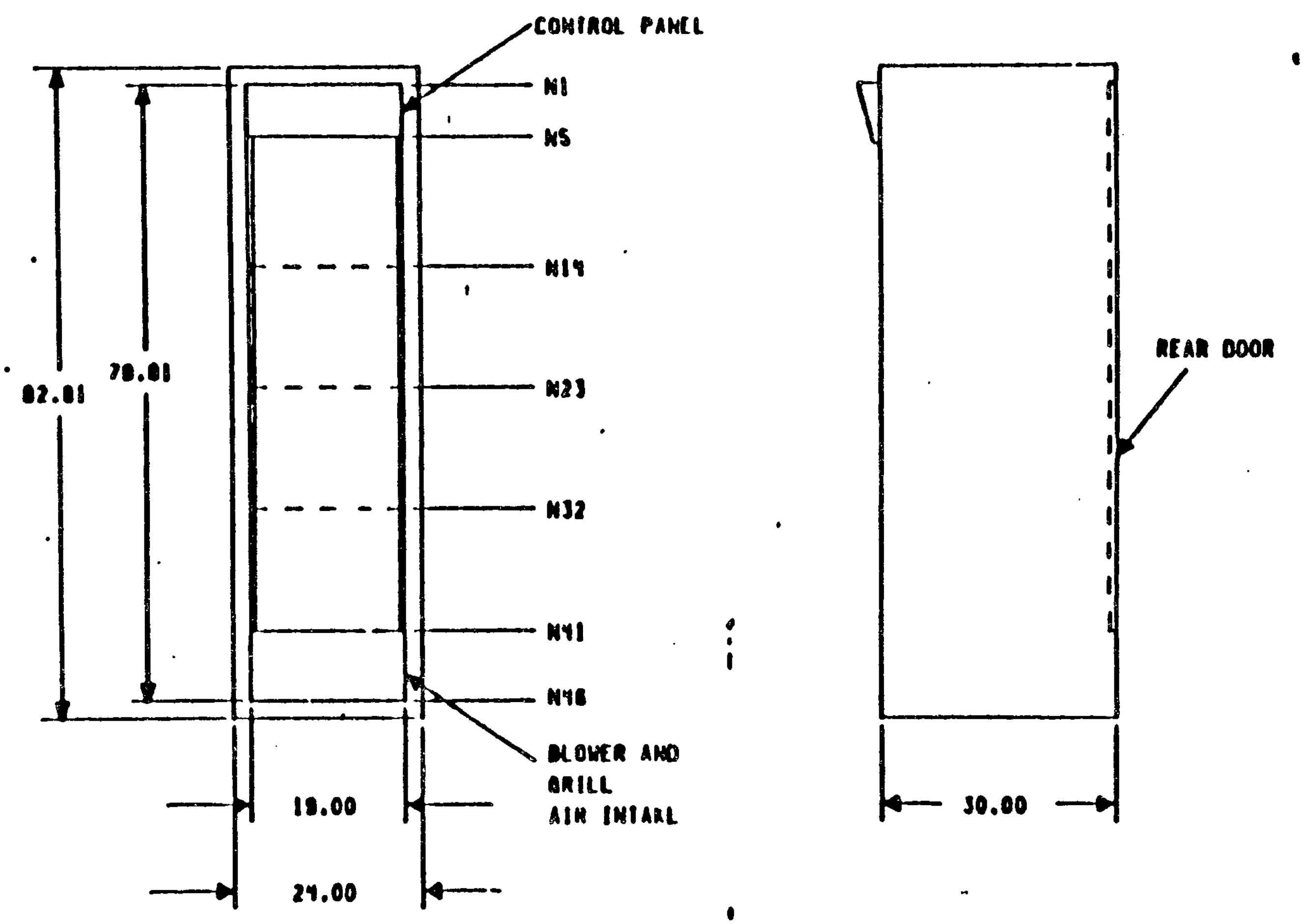


Figure 3.2.6.6-1. Front and Side View of RACK



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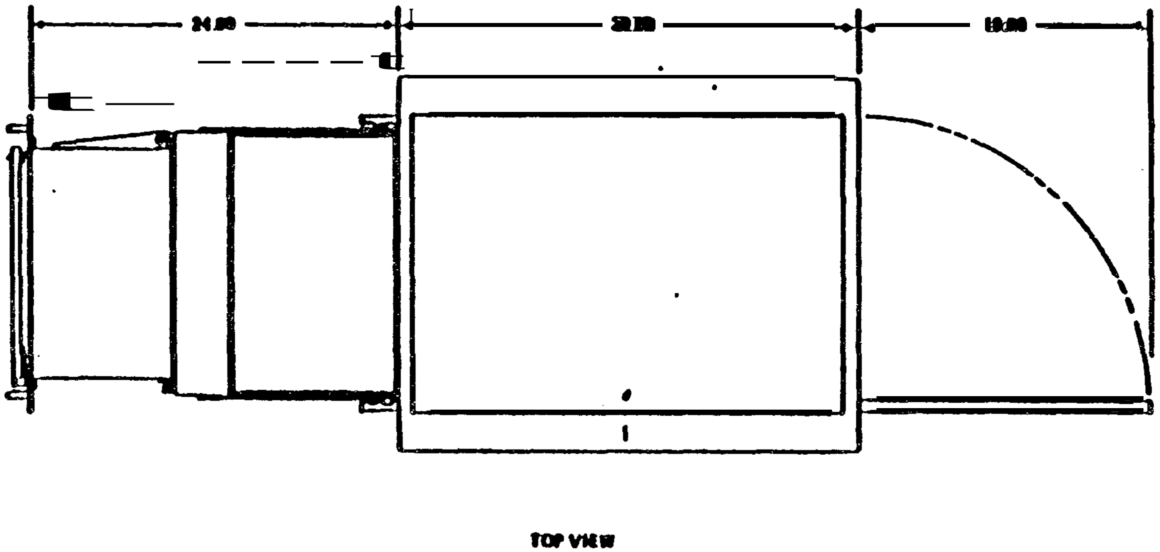
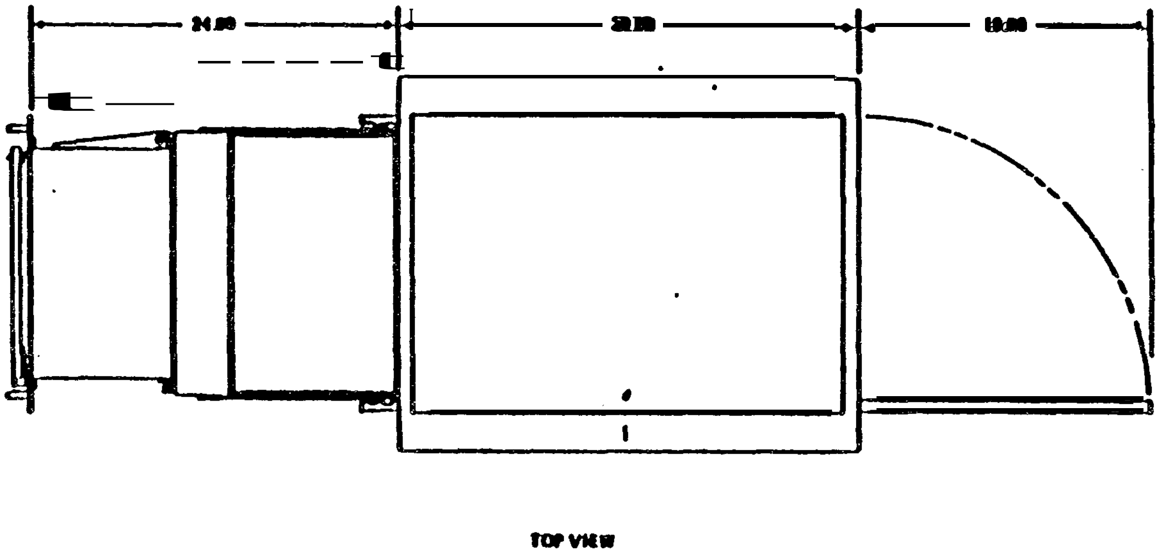


Figure 3.2.6.6-3. Chassis Fully Extended and Rear Door Open



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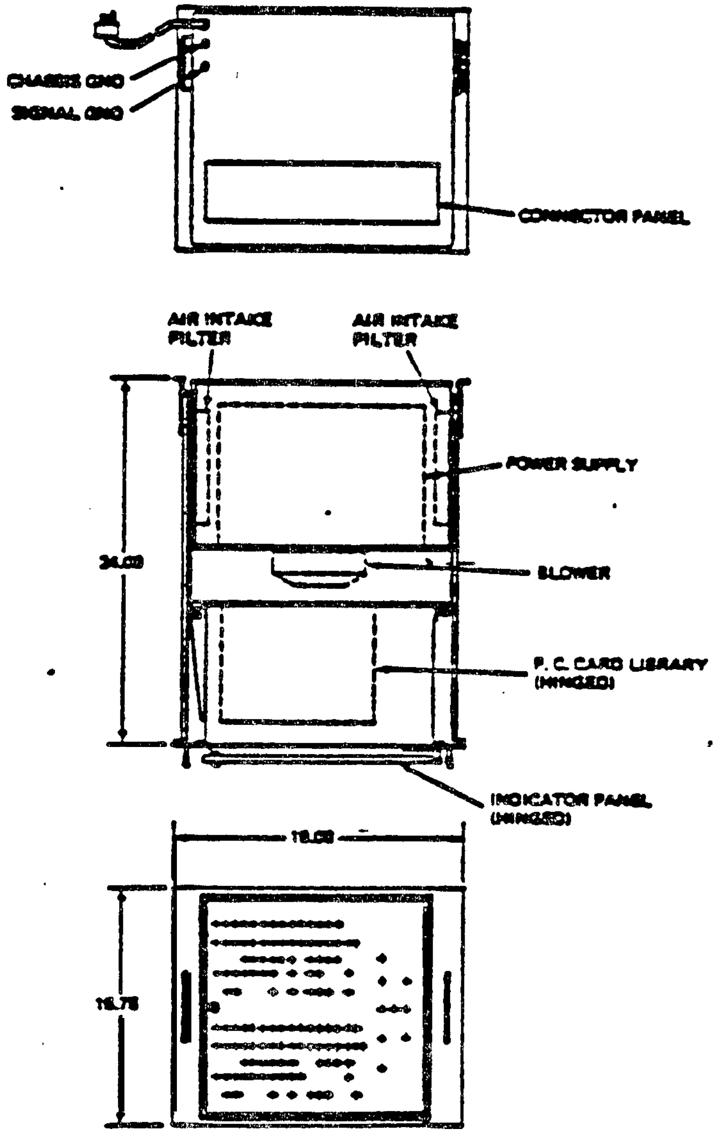

Figure 3.2.6.6-5. Drawer Module Dimensions

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1100.1.4 FDIO INTERFACE

ODAPS shall interface with the FDIO Central Control Units (CCUs) for the exchange of data with FDIO equipment (FSPs, CRTs, and keyboards) at sector positions. It shall be acceptable for the contractor to interface the ODAPS directly with the FDIO Remote Control Units (RCUs) instead of the CCUs for communication with the CRT, keyboards, and FSPs for adoptation for the remot facilities.

1100.1.5 LOCAL CRT DISPLAY

The CRT displays will be located at the sector positions. The ODAPS shall output the following data to discretely addressed CRTs for display:

(a) Flight data messages, updates and alerts thereto;

(b) Winds aloft messages and updates thereto;

(c) Response messages, such as accept, reject and error messages; and

(d) Probe messages.

1100.1.6 REMOTE CRT DISPLAY

CRT displays shall be located at remote positions (IFSS/FSS). The ODAPS shall output the following data to discretely addressed FDIO CRTs for display:

(a) Flight data messages, updates and alerts thereto;

(b) Winds aloft messages and updates thereto;

(c) Response messages, such as accept, reject and error messages;

1100.1.7 FDIO ALPHANUMERIC KEYBOARD INPUT

The ODAPS shall accept (for processing) flight data miscellaneous information, and information request messages input at qualified FDIO keyboards.

1100.1.8 FLIGHT STRIP PRINTER

The flight strip printers will be used to print flight progress and coordination strips, both locally and remotely, and other information as described herein.

1100.1.9 SYSTEM 1.

A System 1 Processor shall be used to interface with the ODAPS/FDP computer in order to handle local and remote displays (not including PVDs), keyboards (not including PVDs) and local remote flight strip printers in the event of delays with the planned FDIO equipment.

Additionally IBM displays, keyboards and printers could be used on the development system prior to the availability of FDIO equipments. IBM can supply the software needed to communicate with these devices eliminating or reducing the software development in this area by the ODAPS contractor.

00.1.1.10 REFERENCES

The following FAA Specifications and Standards form a part of this specificatio and are applicable to the extent specified herein.

FAA-E-2713	Oceanic Display and Planning System (ODAPS) (Coordination Draft), February 1983.
FAA-E-2711	Flight Data Input and Output (FDIO) Replacement System Specification.
EIA RS-449	EIA Standard RS-449, General Purpose 37 - Position and 9 - Position Interface for Data Termina Equipment and Data-Terminating Equipment Employing Serial Binary Data, November 1977.
FED-STD-1003	ANSI X3.66-1979, American National Standard for Advanced Data Communication Control Procedures (ADCCP), January 9, 1979.
FED-STD-1005	TELECOMMUNICATIONS: Coding and and Modulation Requirements for Nondiversity 2400 b/sec Modems.
FED-STD-1006	TELECOMMUNICATIONS: Coding and Modulation Requirements for Nondiversity 4800 b/sec Modems.
NAS-MD-750	NADIN-NAS Interface.
ICAO DOC	Rules of the Air and Air Traffic Services, Procedures 4444-RAC/501/11 for Air Navigation Services, International Civil Aviation Organization (ICAO).
ICAO Annex 10 (Volume II)	Aeronautical Telecommunications, International Standards, Recommended Practices and Procedures for Air Navigation Services, Convention on International Civil Aviation.
ANSI X3.4-1968	The American National Standard Code for Information Interchange.

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APPENDIX 12

1200.0 NADIN TO ODAPS INTERFACE

1200.1 INTRODUCTION

1200.1.1 PURPOSE

This appendix describes the interface requirements which shall be incorporated in the NADIN and Oceanic Display and Planning System (ODAPS) in order to exchange ODAPS data traffic through NADIN. The hardware and procedural characteristics specified herein define communications between the NADIN Concentrator and the ODAPS unit.

1200.1.2 SCOPE

This appendix addresses interface control requirements at three levels:

- o physical, i.e, the communications lines, modems, and the electrical/mechanical connections;
- o link control, i.e., the control of transmission, and
- o message, i.e., the content of actual data transmitted.

1200.2 PHYSICAL CONTROL LEVEL

1200.2.1 COMMUNICATION LINES

1200.2.1.1 PRIMARY LINKS

The communication lines shall be 4-wire, voice grade, non-switched leased lines and shall be configured as multipoint circuits.

1200.2.2 MODEMS

1200.2.2.1 PRIMARY LINKS

Modems capable of hendling full duplex, synchronous transmissions at 2400 bps shall be used to interface the leased lines with ODAPS units and NADIN concentrators. Thus there shall be one such modem at each ODAPS unit and one for each primary circuit (multipoint) at each concentrator. Coding and modulation requirements of Federal Standard 1005 shall be met. The NADIN contractor modem compatible with Bell 201 shall operate with the request to send (CA) signal permanently on. The modem at each ODAPS unit shall activate its carrier signal only when polled by NADIN.

1200.2.2.2 ELECTRICAL/MECHANICAL INTERFACE

The electrical/mechanical interface between the modems and the ODAPS units and the NADIN concentrator shall be in accordance with EIA Standard RS-232C.

1200.3 LINK CONTROL LEVEL

1200.3.1 PROCEDURES

The link level protocol to be used between the ODAPS units and NADIN concentrator shall be the bit-oriented ANSI X3.66, Advanced Data Communication Control Procedure (ADCCP) running in a logical two way alternate mode. ADCCP provides the three classes of procedures. Only one of these shall be used for this interface.

- o Unbalanced Normal (UN) - Such procedures involve one station designated as the primary stations and any number of secondary stations. The primary station controls the link through the transmission of commands. The secondaries transmit responses to commands. Both types of stations can transmit information (e.g., ODAPS Messages); however, secondary stations can do so only in response to a specific command (poll). This class of procedures shall be used for multipoint links between ODAPS units and NADIN concentrators, with the concentrator always designated as the primary station. Control function options (as cited in section 3.8.2 of this document) shall be implemented.

1200.3.2 FRAME STRUCTURE

The unit of transmission under ADCCP shall be the frame. A frame, may, but need not, include a message block (information field); frames with no information field are used for link control only. Each frame transmitted from any type of station shall contain the following, in the order indicated.

(a) An opening flag sequence;
(b) An address field;
(c) A control field;
(d) An information field (optional);
(e) A frame check sequence; and
(f) An ending flag sequence.

Flag	Address Field	Control Field	Information Field (Optional)	FCS	Flag

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(d) An information field (optional);
(e) A frame check sequence; and
(f) An ending flag sequence.

Flag	Address Field	Control Field	Information Field (Optional)	FCS	Flag

1200.3.4.2 GLOBAL AND NULL ADDRESS

The null address -- 00000000 -- shall be used for testing purposes only and shall be ignored by the secondary station function.

1200.3.5 CONTROL FIELD

The control field is used to indicated the nature of the transmission, to communicated commands and resonses between primary and secondary stations and to acknowledge receipt of acceptable information frames. ADCCP permits use of a **one-** or two-octet control field. Only a single octet shall be used for NADIN and ODAPS interface. This limits the number of unacknowledged information frames, from one station to another, to seven. In order to describe the structure of the control field, it is useful first to define a few related parameters and concepts.

1200.3.5.1 CONTROL PARAMETERS AND CONCEPTS

(a) Frame Sequence Number - Each station shall assign a sequence number to each information frame transmitted. A separate sequence of numbers shall be used for each station with which that station communicates. Such sequence numbers must fall in the range of 0 to 7 (000 to 111, in binary notation). Thus, after information frame 7 has been transmitted to a particular station, the next information frame transmitted to that station shall be assigned the sequence number 9 (i.e., the frame numbers are incremented by 1, modulo 8). A maximum of seven unacknowledged frames may exist between any two stations in either direction.

(b) Send Variable - Each station shall maintain a set of send variables, **S9B).** Each of these variables shall be initialized to 0 and then incremented by 1, modulo 8, whenever the transmission of an information frame to the particular station (B) is completed. **S(B)** shall not be incremented when a frame is aborted.

(c) Receive Variable - Each station shall similarly maintain a set of receive variables, R(A), which shall be initialized to). Each of these variables shall be incremented by 1, module 8, whenever an information frame with sequence number equal to R(A) is received from the particular station (A). Note that since all ODAPS stations both send and receive messages, each shall maintain both send and receive variables.

	b1	b2	b3	b4	b5	b6	b7	b8
ADIN NCENTRATOR	1	1	1	0	0	0	0	1
DDAPS Unit No. 1	1	1	0	0	0	0	0	0
DDAPS Unit No. 2	1	0	1	0	0	0	0	0
DDAPS Unit No. 3	1	0	0	1	0	0	0	0
DDAPS Unit No. 4	1	0	0	0	1	0	0	0
DDAPS Unit No. 5	1	0	0	0	0	1	0	0

TABLE 1: LINK ADDRESS ASSIGNMENT

	b1	b2	b3	b4	b5	b6	b7	b8
ADIN NCENTRATOR	1	1	1	0	0	0	0	1
DDAPS Unit No. 1	1	1	0	0	0	0	0	0
DDAPS Unit No. 2	1	0	1	0	0	0	0	0
DDAPS Unit No. 3	1	0	0	1	0	0	0	0
DDAPS Unit No. 4	1	0	0	0	1	0	0	0
DDAPS Unit No. 5	1	0	0	0	0	1	0	0

TABLE 1: LINK ADDRESS ASSIGNMENT

6. The third and fourth bits of the control field supervisory frames (designated C) shall be used to identify the specific supervisory function. These are discussed later.

7. Bit positions 3, 4, 6, 7, and 8 in unnumbered frames (designated M) shall be used to identify the specific unnumbered function. These also are defined later.

1200.3.6 INFORMATION FIELD

When included, the information field shall be transparent to ADCCP, i.e., the link control procedures shall accept any sequence of bits as an information field. There shall, however, be a limit on the size of the field. For ODAPS application, this limit shall be 2000 bits (or 250 8-bit chatacters), excuding the zero insertion bits discussed earlier. In order to transmit longer messages, the messages shall be broken into two or mor blocks of 2000 (or fewer) bits and each block shall be transmitted in a separate frame.

Information frames shall almost always include an information field. Supervisory frames shall never include an information field. Generally, unnumbered frames shall not include such fields. There is one exception, however. If a non-reserved function (also discussed later) is used, an information field may be included in the frame.

1200.3.7 FRAME CHECK SEQUENCE

The frame check sequence (FCS) shall be a 16-bit (2 octet) number generated at the transmitting station by applying a special algorithum to the string of bits that make up the address field, the control field and (if present) the information field, prior to zero insertion. The value of the FCS shall be determined and transmitted as part of each frame.

The receiving station, after removing the flag sequences and the inserted zeros, shall determine if the received FCS is consistent with the remainder of the transmission. Inconsistency implies an error in transmission and shall cause the tramsission to be unacceptable.

Appendix D to ANSI X3.66-1979 defines the FCS in detail and suggests techniques for implementing this process.

1200.3.8 CONTROL FUNCTIONS

As indicated earlier, ADCCP provides for a variety of control functions. These are defined as a series of basic commands and responses together with a series of optional commands and responses. The referenced ANSI standard for ADCCP describes all of these function in detail. The following outlines those that shall be implemented for ODAPS and NADIN interface. In particular the RSET, SREJ, UI, UP, RIM, and SIM commands and responses shall not be used.

1200.3.8.1 BASIC FUNCTIONS

The basic control functions shall include both commands (i.e., from primary stations) and response (i.e., from secondary stations). The following identified these functions as they apply to ODAPS and NADIN interface:

Function	Type	Meaning
I	C&R	Information being transferred
RR	C&R	Receive Ready
RNR	C&R	Receive Not Ready
FRMR	R	Frame Reject
SNRM	C	Set Normal Response Mode
DISC	C	Disconnect
UA	R	Unnumbered Acknowledgement
DM	R	Disconnected Mode

*C = Command; R = Response

1200.3.8.2 OPERATIONAL FUNCTIONS

ADCCP provides eleven options for adding or deleting control functions. The one that shall be implemented for ODAPS are:

Option #	Add/ Delete	Type	Function	Meaning
lb	A	R	RD	Request Disconnect

*A - Add function; D = Delete function; C = Command; R = Response

In addition ADCCP provides up to four non-reserved functions that can be defined and implemented by the system designer. No such functions are envisioned as being needed.

1200.3.8.3 FUNCTION CODES

the various functions indicated above shall be designated through codes in the control field of a frame. The information transfer function, I, shall be designated directly by the use of an information transfer format (0 in bit position 1). The remaining functions shall be designated as follows:

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1200.3.9.1 TIMER FUNCTIONS

The time-out functions specified in this section represent the minimum requirements and do not preclude other time-out functions. The necessary timers and thier functions are:

- Poll Timer - used at a primary station to detect the lack of a response to a poll. Also used to delimit the check point cycle in the absence of a poll response.

- information Ack Timer - used to detect missing or unacknowledged information frames that will not show up as an out-of-sequence exception. This timer is important is and when a single or final information frame is transmitted which does not contain a P bit set to "1".

- Busy (RNR) Timer - used by secondary station to determine when it can resume sending I frames to a primary station that has sent a RNR command and has not cleared the bury condition by other means.

- Idle Timer - used by a primary station to insure that a secondary station is polled if there is no transmission in either direction fr a specified time duration.

1200.3.9.2 TIMER VALUES

At a minimum timers shall be adjustable in increments of seconds over the range 1 to 120 seconds. Initial settings shall be as shown in Table 2 in terms of uper and lower limits.

1200.3.9.3 ACKNOWLEDGEMENT

Each time a station receives an information or supervisory frame, it expects aknowledgement (through the N(R) parameter) of information frames it transmitted. to facilitate retransmission of unacknowledge information frames, each station shall implement checkpoint recovery, as follows:

- A checkpoint cycle is defined for a primary station as the period between the transmission of a frame with the P bit set to 1 and either (1) the next receipt of a frame with the F bit set to 1 from the secondary to which the poll bit was directed, or (2) the expiration of the poll times, whichever occurs first. However, a cycle does not end with an unnumbered frame.

- When a primary station receives a frame with the F bit set to "1", or when the secondary station receives a frame with the P bit set to "1", the station will initiate retransmission of all unacknowledged I frame with sequence numbers less than the send variable (S) at the time the last frame with the P bit set to "1" (primary) or frame with the F bit set to 1 (secondary) was transmitted. Retransmission starts with the lowest numbered unacknoledged I frame. I frames are retransmitted sequentially. New frames may be transmitted if ther become available. Such retransmission if I frame is known as checkpoint retransmission.

- See ADCCP, ANSI X 3.66 - 1979 for further details and exceptions.

00.3.9.4 BUSY CONDITION

When a station temporiarily cannot receive or continue to receive information frames due to internal constraints (e.g., buffer limitation), it shall notify the transmitting station by sending an RNR frame and report this condition to the supervisor function. Upon receipt of an RNR frame, a station shall not transmit new information frames to the busy station. Clearance of the busy condition shall be reported by transmission of an RR, SNRM, of UA frame with or without the P/F bit set to 1; or transmission of an information frame with the P/F bit set to 1. If the busy condition has not been cleared by other means, the expiration of the busy condition timer enables a secondary station to resume transmission of I frames to the primary station. The system supervisor function shall be noified when the busy condition is cleared.

00.3.10 **ERROR CONTROL**

00.3.10.1 FRAME CHECK SEQUENCE

The frame check sequence (FSC) shall be a 16-bit (2 octet) number generated at the transmittin station by applying a special algothrim to the string of bits that make up the address field, the control field and (if present) the information field, prior to zero bit insertion. The value of the FCS shall be determined and transmitted as part of each frame.

The receiving station, after removing the flag sequences and the inserted zeros, shall determine if the received FCS is consistent with the remainder of the transmission. Inconsistency implies an error in transmission and shall cause the transmission to be unacceptable.

- When a primary station receives a frame with the F bit set to "1", or when the secondary station receives a frame with the P bit set to "1", the station will initiate retransmission of all unacknowledged I frame with sequence numbers less than the send variable (S) at the time the last frame with the P bit set to "1" (primary) or frame with the F bit set to 1 (secondary) was transmitted. Retransmission starts with the lowest numbered unacknoledged I frame. I frames are retransmitted sequentially. New frames may be transmitted if ther become available. Such retransmission if I frame is known as checkpoint retransmission.

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The receiving station, after removing the flag sequences and the inserted zeros, shall determine if the received FCS is consistent with the remainder of the transmission. Inconsistency implies an error in transmission and shall cause the transmission to be unacceptable.

00.4.2.1 ADDRESS LINE(S)

1	2	3	4	5
Start of Header	Priority	Priority	Address	End of Address

Field 1 Start of Header (SOH)

- o Characters 0/1 always present
- o Croup Separator (1/13) (optiona on a circuit basis)

Field 2 Prioirty

- o 2 alphabetic character priority indicators
- o Always present

Field 3 Delimiter

- o Space, character 2/0
- o Always present

Field 4 Address

- o 6 or 8 alpha characters ICAO address
- o Additional addresses may be added with each preceded by a space character
- o Maximum of 3 lines
- o Each line of address shall be completed with CR LF, ecept the last line which shall end with End of Address
- o Always present

Field 5 End of Address

- o Carriage Return, Line Feed, File Separator, character (1/12)
- o Always present

00.4.2.1 ADDRESS LINE(S)

1	2	3	4	5
Start of Header	Priority	Priority	Address	End of Address

Field 1 Start of Header (SOH)

- o Characters 0/1 always present
- o Croup Separator (1/13) (optiona on a circuit basis)

Field 2 Prioirty

- o 2 alphabetic character priority indicators
- o Always present

Field 3 Delimiter

- o Space, character 2/0
- o Always present

Field 4 Address

- o 6 or 8 alpha characters ICAO address
- o Additional addresses may be added with each preceded by a space character
- o Maximum of 3 lines
- o Each line of address shall be completed with CR LF, ecept the last line which shall end with End of Address
- o Always present

Field 5 End of Address

- o Carriage Return, Line Feed, File Separator, character (1/12)
- o Always present

1200.4.2.3 MESSAGE TEXT

TEXT BLOCK

1	2
Start of Text	Text

Field 1 Start of Text **(STX)**

- o Characters **0/2**
- o Always present

Field 2 Text

- o 80 characters per line
- o Lines separated by CR LF
- o Always present

1200.4.2.4 ENDING

1	2
Alignment Function	End of Text

Field 1 Alignment Function

- o Carriage return, line feed
- o Always present

Field 2 End of Text **(ETX)**

- o Character **0/11 (VT)**
- o Character **0/3 (ETX)**
- o Always present

1200.4.3 SERVICE MESSAGE FORMAT

Service message format shall be as described in Section W-4.2. Text shall be in accordance with the body of the specification (see Section 3.3.2, 3.3.4, and 3.4.7.8.b).

TIMER	LOWER LIMIT	UPPER LIMIT
Poll	2	5
I-Frame Response	2	5
Busy (RNR)	5	120
Idle	2	30
Set Normal Response Mode (SNRM)	10	15

TABLE 2: TIMER VALUES LIMITS (SECONDS)